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JPRS 81551

17 August 1982

19981208 040

USSR Report

EARTH SCIENCES

No. 22

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METEOROLOGY

UDC 551.515.8

HYDRODYNAMIC MODEL OF NONSTATIONARY ATMOSPHERIC FRONT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 5, Apr 82
(manuscript received 1 Dec 81) pp 1105-1107

SHAPIRO, G. I., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] The author proposes a hydrodynamic model of an atmospheric front which takes into account the earth's rotation, the presence of turbulent viscosity and the vertical air pressure gradient. An evolutionary equation was derived for the altitude of the frontal surface and on this basis it was possible to analyze the effects associated with the nonstationary character and the three-dimensionality of air movement. It was found that although the derived equation is not precisely identical to the equation derived by Defant for describing the evolution of an atmospheric front many of the qualitative conclusions drawn by Defant remain correct. The derived equation describes the motion of a nonlinear wave in a medium with nonlinear "viscosity." In a limiting case the equation coincides with the equation describing the evolution of a microscale oceanic front. In another special case of two-dimensional stationary movements the equation can be reduced to an equation derived within the framework of a two-dimensional stationary model. One of the phenomena which can be explained within the framework of the proposed model is an increase in the curvature of a cold front in the surface air layer near the center of a cyclone. Figures 1; references 7: 5 Russian, 2 Western.
[146-5303]

UDC 551.578.46:551.324:551.588.5

ROLE OF SNOW COVER AND GLACIERS IN GLOBAL CLIMATE MODELS

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOGRAFICHESKAYA in Russian No 1, Jan-Feb 82 (manuscript received 19 May 81) pp 5-14

KOTLYAKOV, V. M. and KRENKE, A. N., Geography Institute, USSR Academy of Sciences

[Abstract] This report was presented at an international conference on allowance for the underlying surface in global models of atmospheric circulation and climate at Greenbelt, Maryland, during the period 5-10 January 1981. The first part of the paper is a general review of the world distribution of snow cover and glaciers, accompanied by two tables of pertinent data. This is followed by a discussion of the influence of snow cover and glaciers on climate and the parameters needed in constructing climatic models. A general survey then is presented which covers: observations at meteorological stations, surface and remote snow-measuring surveys, photography from aircraft and space vehicles and measurements of radiations at different wavelengths. The availability of archival data on snow cover and glaciers is defined with an indication of where the information is stored and what areas have good and poor coverage. It is noted that satellite observations will afford the greatest possibilities for filling gaps, upgrading the quality of data collected and monitoring snow and ice throughout the year and from year to year. It is very important to collect regular data on the position of the boundary of seasonal snow and the snow-melting front from visible and near-IR images. Active and passive radar can be used effectively in estimating snow reserves. A satellite survey of the relief of continental ice sheets should be completed. The rates of glacier movement should be determined by satellite geodesy. There is need for a global surface network for observing accumulation, ablation and air temperature over glaciers and ice sheets, as well as a network of boreholes in the ice for reconstructing past climates. Tables 2; references 50: 23 Russian, 27 Western. [115-5303]

UDC 538.561:551.576

POSSIBLE MECHANISM OF RADIO EMISSION BY CONVECTIVE CLOUDS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 6, Feb 82 (manuscript received 5 Oct 81) pp 1344-1347

KALECHITS, V. I., NAKHUTIN, I. Ye. and POLUEKTOV, P. P., All-Union Scientific Research Institute of Inorganic Materials, Moscow

[Abstract] A new type of radio emission of thunderstorm clouds has been discovered in recent years in a wide frequency range; this is not directly related to lightning. The mechanism of this continuous-noise emission is described in

this article. Convective clouds constitute an ensemble of droplets whose size and concentration vary in a wide range. Droplets in a cumulonimbus cloud with a radius $R \approx 1 \mu\text{m}$ have a charge of about 20 e and for $R \approx 1 \text{ mm} \rightarrow 10^8 - 10^{10} \text{ e}$. An increase in droplet size occurs largely by coalescence and this is accompanied by excitation of surface oscillations of the droplet. Since the droplet is charged the oscillations of form cause the generation of electromagnetic radiation, the essence of the observed continuous-noise radio emission of clouds. The authors first determine the natural oscillations of a conducting charged liquid droplet and the conditions for droplet stability and its radio emission spectrum. A dispersion equation is derived for surface oscillations of a charged liquid droplet which reveals that in the presence of a charge the frequencies of droplet oscillations decrease and attenuation increases; when the oscillations reach the zero frequency the limit of droplet stability is reached. Since coalescence occurs in a thunderstorm cloud without interruption, the emission of electromagnetic waves is continuous. A hydrometeor with $R_0 \approx 1 \text{ mm}$, moving in a cloud of droplets with $r \approx 10 \mu\text{m}$, for example, emits a power $W \approx 2 \cdot 10^{-16} \text{ W}$ at $\sim 120 \text{ KHz}$; a cumulonimbus cloud of average size (5 km) has an emissivity of about $3 \cdot 10^{-2} \text{ W}$. These and other facts confirm that electromagnetic radiation of oscillating charged droplets is the source of continuous-noise radio emission of prethunderstorm and thunderstorm clouds. References 15: 10 Russian, 5 Western. [119-5303]

UDC 551.50

EVALUATIONS OF CENOZOIC CLIMATIC VARIATIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 2, Mar 82 (manuscript received 6 Oct 81) pp 451-453

VERBITSKIY, M. Ya. and CHALIKOV, D. V., Leningrad Division, Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] The climate of the Cenozoic has been poorly understood and the authors have sought to remedy this by an evaluation of climatic variations during that era on the basis of one-dimensional models of the atmosphere and glacier cover. The computations and tabulated data reveal that in the Paleocene and Eocene the climate was warmer than now, latitudinal temperature gradients were more poorly expressed and meridional heat transport was less intensive. The only glacier was at the center of Antarctica. But 38 million years ago the ocean surface temperature dropped due to the formation of a deep strait between Antarctica and Australia, this leading to cooling and expansion of Antarctic glaciation. The latitudinal temperature gradients in the ocean became more clearly expressed 12 million years ago, accompanied by an increase in latitudinal atmospheric temperature gradients, with atmospheric meridional heat transport becoming more intense. The model is broken down into 1) Paleocene and Eocene, 2) Oligocene, Early and Middle Miocene, 3) Late Miocene and

Early Pliocene, and 4) present day. The values for each of these epochs were computed for the following parameters: mean atmospheric temperature, mean vertical atmospheric temperature, temperature of continents, mean radius of Antarctic ice sheet, mean thickness of Antarctic ice sheet and meridional heat transport. All these data are summarized in Table 2. Tables 2; references 11: 5 Russian, 6 Western.

[141-5303]

OCEANOGRAPHY

VOYAGES OF SCIENTIFIC SHIPS DURING JUNE-DECEMBER 1981

Moscow ZEMLYA I VSELENNAYA in Russian No 3, May-Jun 82 pp 40-41

[Article by A. A. Goncharenko]

[Text] In the second half of 1981 the scientific research fleet of the USSR Academy of Sciences and the academies of sciences of the union republics continued investigations of the world ocean and marginal seas in accordance with national and international programs.

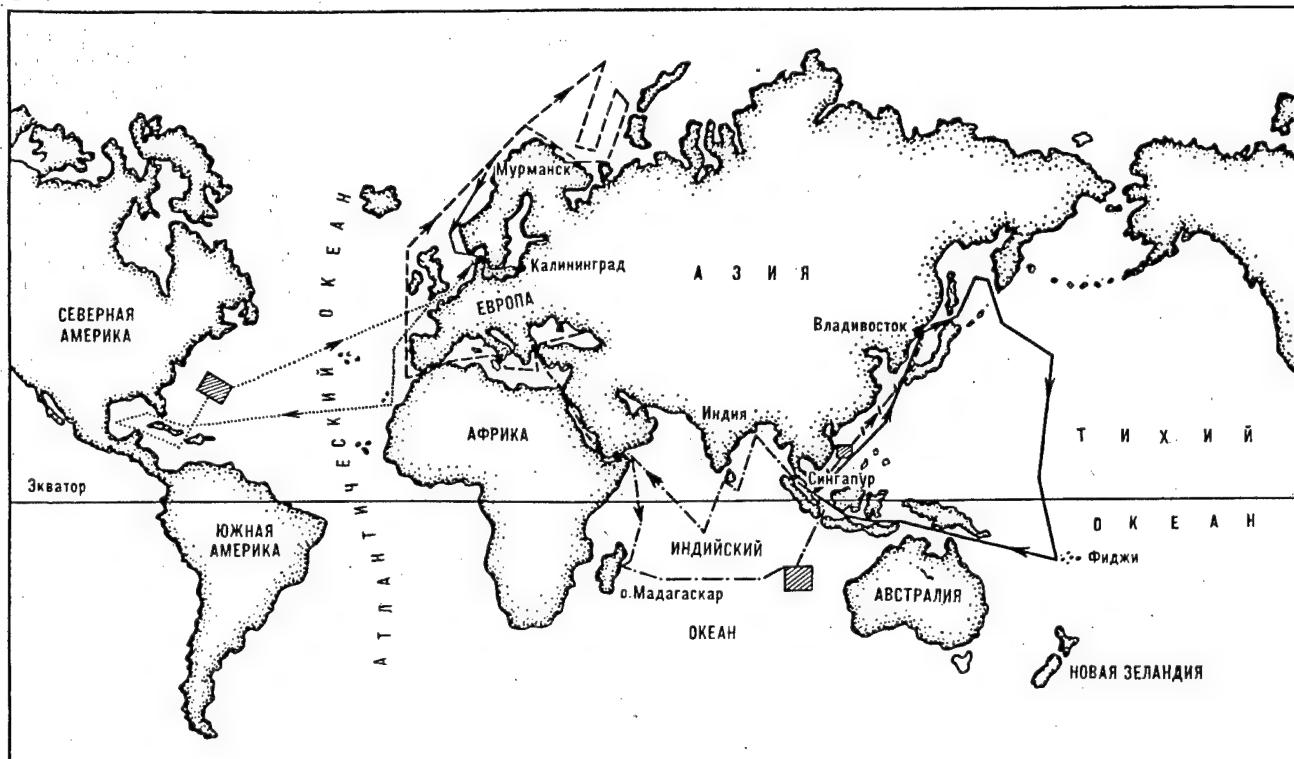
In addition, the Academy fleet was supplemented by the new scientific research ship "Akademik Mstislav Keldysh" (ZEMLYA I VSELENNAYA, No 5, p 66, 1981 -- Editor). The ship made two voyages in the Atlantic, investigating dynamic noise, scattering and reflection of sound by the bottom and the water layer of the ocean, interaction of microstructure and internal waves.

An expedition on the ship "Professor Shtokman" (Institute of Oceanology, USSR Academy of Sciences) worked in the Barents Sea. A study was made of the structure of the sedimentary layer and the earth's crust in the main tectonic structures and in several sectors where the probability of discovery of petroleum and gas is most likely. A seismic survey with a total extent of about 9000 km was carried out, as well as deep seismic sounding, geomagnetic and geothermal measurements.

In the northwestern part of the Pacific Ocean the Institute of Oceanology, USSR Academy of Sciences, made observations on two vessels: "Akademik Kurchatov" and "Dmitriy Mendeleev." It was necessary to investigate the characteristics of the ocean and hydrological fields in the polar front zone. This included an experimental study of synoptic disturbances (rings, eddies in the open ocean), internal gravitational waves, temperature and conductivity fields, and currents. On the basis of the collected data a realistic scheme was proposed for the subarctic frontal zone: it brings together the structure of the water masses, the system of currents and fronts.

The scientific research ship "Akademik Vernadskiy" of the Marine Hydrophysical Institute, Ukrainian Academy of Sciences, worked in the Indian Ocean. During this voyage specialists carried out multisided oceanographic and geo-physical investigations in a polygon in the neighborhood of the Saya de Malha

Bank and also in the interests of the fishing industry made two hydrological runs near Western Australia. On the atolls and reefs in the Indian Ocean botanists collected several ten thousands of samples of plants and animals.



Tracks of scientific research ships. The shaded rectangles represent polygons where investigations were made.

.....	"Academician M. Keldysh"	— / —	"Kallisto"
- - - - -	"Professor Shtokman"	—	"Akademik Kurch-
- . - . -	"Akademik Vernadskiy"	—	atov" and "Dm. Mendeleyev"

Another ship of this same institute, the "Mikhail Lomonosov," made a voyage for developing means and methods for a multisided study of the Black and Mediterranean Seas and the Eastern Atlantic. Material was obtained making it possible to interpret the results of remote measurements of hydrophysical characteristics.

Aboard the scientific research ship "Ayu-Dag" (Institute of Thermophysics and Electrophysics, Estonian Academy of Sciences) specialists continued to study geophysical fields and the optical properties of water masses, as well as the content of toxic substances in the ecosystem of the sea, in the open part of the Baltic Sea. Incidentally, under the conditions prevailing in the Baltic Sea during the summer-autumn season it was possible to clarify the interrelationship between hydrological, optical and chemical processes.

The sail-engine nonmagnetic schooner "Zarya" (Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences) was again sent on a voyage in the Baltic. Interesting material was obtained for magnetic cartography, in particular for constructing a composite map of components of the earth's magnetic field for the area of the Baltic Sea at a scale of 1:1 000 000.

An expedition on the "Kallisto" of the Far Eastern Scientific Center, USSR Academy of Sciences, worked in the Sea of Okhotsk and then in the South China Sea. In the first stage a study was made of the bedrock bottom, on the basis of which material was prepared for compiling a geological map of the Sea of Okhotsk. In addition, a study was made of the structure of the upper part of the earth's crust and the accumulation of the most important components (in particular, organic carbons) in recent and ancient sediments. In the second stage the gravimetric, magnetometric and continuous seismic profiling methods, including echo sounding, were used in running of a regional profile across the entire area of the sea.

The "Professor Bogorov," a ship of the Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, visited the north-western part of the Pacific Ocean, as well as the Sea of Okhotsk and the Sea of Japan. New data were collected on the characteristics of meso- and micro-scale disturbances of hydrophysical fields in typical regions of the subarctic zone.

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CSO: 1865/163

KINETIC ENERGY FIELD IN WORLD OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 5, Apr 82 (manuscript received 6 Aug 81) pp 1229-1232

STEPANOV, V. N., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] Data on the velocity of transport of ocean waters from the surface to the bottom obtained using the A. S. Sarkisyan linear-diagnostic model enabled the author to estimate for the first time the energy of world circulation of waters, the energy in macroscale cyclonic and anticyclonic systems, and map the patterns of change in the quantity of energy with depth in the ocean. The kinetic energy fields were plotted for the most characteristic surfaces (0, 200, 1000, 2000, 300 and 4000 m). Although it could be assumed that the mean kinetic energy computed on the basis of drifting of ships (as in a study by K. Wyrtki, et al., JGR, Vol 81, No 15, 1976) would be substantially greater than the values determined using a diagnostic model, in general the results were very close. On the maps it is very easy to trace macrocirculation systems, in the central parts of which the kinetic energy drops off to $10 \text{ cm}^2 \cdot \text{sec}^{-2}$ or less; toward the periphery it increases to $50-100 \text{ cm}^2 \cdot \text{sec}^{-2}$. The highest values are in the zone of the Trades currents, in general more than $200-300 \text{ cm}^2 \cdot \text{sec}^{-2}$, locally more than $500 \text{ cm}^2 \cdot \text{sec}^{-2}$. A second extensive zone of the same high kinetic energy values is associated with the Antarctic Circumpolar Current. There is a restructuring of the kinetic energy field with increasing distance from the ocean surface. The first is at a depth of 50-100 m, persisting to a depth of about 500 m. Below there is a second significant restructuring of the circulation of waters with a corresponding change in the velocity field. At a depth of 1000 m the mean velocity for the entire ocean is four times less than at the surface and the kinetic energy is approximately three times less. Beginning approximately from a depth of 500-1000 m (lower intermediate, deep and upper bottom waters) the kinetic energy field is characterized by low values in the entire world ocean, except for the tropical latitudes. In the low latitudes a high energy persists from the surface to the bottom. Figures 1; references 3: 2 Russian, 1 Western.

[146-5303)

MANIFESTATION OF STRUCTURES OF ABYSSAL TRENCHES IN NORTHWESTERN PACIFIC OCEAN IN GEOMAGNETIC FIELD

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 5, Apr 82 (manuscript received 22 Jun 81) pp 1108-1111

SHEVALDIN, Yu. V., Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok

[Abstract] An anomalous magnetic field is manifested in many ways in the abyssal trenches in the northwestern Pacific Ocean. In some trenches the anomaly extends along the entire strike, whereas in others it is discontinuous. The trench axis is most commonly in the central part of the anomaly, but in other cases the anomaly is asymmetric. The transverse dimensions of the geomagnetic anomalies coincide with the similar parameters of residual positive gravity anomalies. A comparison of features of the magnetic field and residual gravitational anomalies in "arc-trench" systems indicates a correlation between anomalies of the T field and deep crustal structures developed beneath the trenches. A block structure of the basement symmetric relative to the trench axis in most cases is reflected in the magnetic field. The features of the anomalous magnetic field, gravity anomalies associated with the trenches and seismological data cannot be explained by the mechanism of subduction of oceanic plates. Trenches instead are a surface manifestation of compensatory structures. The proposed model of formation of abyssal trenches explains facts not earlier having a satisfactory explanation. The degree of expression of these anomalies is essentially dependent on the strike of the trenches. They are manifested with the greatest contrast over trenches of sublatitudinal and northeasterly (northwesterly) strikes. Figures 1; references 3: 2 Russian, 1 Western.

[146-5303]

UDC 551.466.6

REFLECTION AND REFRACTION OF TOPOGRAPHIC ROSSBY WAVES

Moscow OKEANOLOGIYA in Russian Vol 22, No 2, Mar-Apr 82 (manuscript received 20 Jan 81) pp 165-169

VOLOSOV, V. M., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] This is essentially a continuation of the author's previous investigations of this problem published in recent years in OKEANOLOGIYA: "Nonlinear Topographic Rossby Waves," Vol 16, No 3, 1976; "Nonlinear Theory of Topographic Rossby Waves," Vol 16, No 5, 1976; "Nonlinear Theory of Barotropic Currents Over Anisotropic Ocean Bottom Relief," Vol 16, No 6, 1976; "Linear Theory of Macroscale Currents Over Anisotropic Bottom Relief for a Two-Layer Ocean Model," Vol 20, No 1, 1980; "Linear Theory of Macroscale Currents Over Anisotropic Ocean Bottom Relief for a Continuously Stratified Ocean Model," Vol 20, No 4, 1980. Here the developed theory is modified for studying barotropic topographic Rossby waves experiencing reflection and refraction during propagation over a mean-depth drop of a homogeneous ocean with anisotropic microscale bottom relief. The amplitudes of the reflected and refracted waves and the velocities of the particles are determined and the transmission and reflection coefficients are computed. A detailed examination is presented for the special cases of propagation without reflection, total internal reflection and formation of exponentially damping waves. A physical interpretation of the results of these computations is followed by some generalizations. References 9: 8 Russian, 1 Western.

[148-5303]

UDC 551.465.062

EFFECT OF SYNOPTIC EDDIES ON HEAT CONTENT DISTRIBUTION IN SARGASSO SEA

Moscow OKEANOLOGIYA in Russian Vol 22, No 2, Mar-Apr 82 (manuscript received 9 Mar 81) pp 170-173

BULGAKOV, N. P. and POLONSKIY, A. B., Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Sevastopol'

[Abstract] The effect of eddy formations on the distribution of water heat content in the active layer and main thermocline was studied using observational data collected on expeditions of the Marine Hydrophysical Institute during the POLYMODE project. The sounding data used were for depths 0-1500 m obtained with the ISTOK apparatus on three voyages of the "Akademik Vernadskiy" and hydrological observations made on an earlier voyage. Heat content was ascertained for the layers 0-200, 0-1500 and 200-1500 m in different types of

eddy formations. Synoptic inhomogeneities in the temperature field are manifested most clearly on the basis of the distribution of heat content in the layer 200-1500 m, the characteristic heat content of this layer outside eddies being $14\ 500^{\circ}\cdot\text{m}$, whereas in eddies in the open ocean this quantity varies in the range from $13\ 750^{\circ}\cdot\text{m}$ (cyclonic eddies) to $16\ 830^{\circ}\cdot\text{m}$ (anticyclonic eddies). The horizontal heat content gradients vary considerably in time and space, depending on the nature of the eddy field. Intense eddies lead to a considerable increase in the horizontal gradients of heat content. The heat content anomalies in the active (0-200 m) and baroclinic (200-1500 m) layers attributable to synoptic variability do not always coincide in sign. Cyclonic eddies are frequently accompanied by an increase in the heat content of the active layer, whereas anticyclonic eddies are characterized by a decrease in the heat content. Even when eddy formations are not manifested in the field of thermal characteristics of the active layer they are clearly expressed in the field of current velocity. The maximum velocities are observed under the seasonal thermocline. Figures 3; references 8: 7 Russian, 1 Western.

[148-5303]

UDC 551.465.6(27).(265.5)

STRUCTURE OF EQUATORIAL CURRENTS IN CENTRAL AND WESTERN PACIFIC OCEAN

Moscow OKEANOLOGIYA in Russian Vol 22, No 2, Mar-Apr 82 (manuscript received 15 Jun 81, after revision 3 Apr 81) pp 174-177

BUBNOV, V. A., YEGORIKHIN, V. D. and OSADCHIY, A. S., Atlantic Division, Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Kaliningrad; Southern Division, Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Gelendzhik

[Abstract] Five series of current measurements were made during the 24th voyage of the "Dmitriy Mendeleyev" during February-April 1980 in the central and western parts of the equatorial zone of the Pacific Ocean from abroad the drifting ship. The measurements were made using 8-10 BPV-2 automatic current recorders distributed vertically with an interval of 15-20 m, with a discreteness of measurements of 5 min and a duration of measurements at each horizon of 30-60 minutes. Data were obtained on the vertical structure of the velocity field at the equator in the upper 500-700-m layer. A figure shows the vertical profiles of the zonal current velocity component for each of the five stations occupied. At the two stations in the west-central part of the equatorial Pacific there was a clear tendency to a deepening of the core of the Cromwell Current in comparison with the more easterly regions. The maximum current velocities were $50-60\ \text{cm}\cdot\text{sec}^{-1}$, although later observations gave $100-110\ \text{cm}\cdot\text{sec}^{-1}$. The lower boundary of the current was at 260-280 m. At three stations in the west-equatorial region a noteworthy feature of the dynamics of waters in the transitional period from a monsoonal wind regime to a Trades regime is the formation of a two-core structure of the easterly subsurface equatorial countercurrents. Figures 1; tables 1; references 13: 5 Russian, 8 Western.

[148-5303]

UDC 551.465.5:551.463

ALLOWANCE FOR SEA WATER COMPRESSIBILITY WHEN COMPUTING CURRENTS

Moscow OKEANOLOGIYA in Russian Vol 22, No 2, Mar-Apr 82 (manuscript received 4 Mar 81) pp 179-181

GURETSKIY, V. V., Arctic and Antarctic Scientific Research Institute, Leningrad

[Abstract] In dynamic oceanology the dependence of density on pressure is frequently assumed equivalent to its dependence on depth and therefore this is not taken into account in computations of currents. For example, atlases usually give density computed on the basis of temperature and salinity at atmospheric pressure. In this article it is demonstrated that this assumption can result in serious errors: identical differences in the temperature field, with pressure taken into account, lead to unlike differences in the density field. The effect of water compressibility on diagnostic computations of currents was investigated by making computations of circulation in the Antarctic Ocean. Two variants of the computations were made: 1) with density values computed using the Knudsen equation of state at atmospheric pressure and 2) with in situ density values with the mean compressibility coefficient computed using the Ekman formula. The mapped values reveal that eastward water transport in the zone 40-70°S increased from 60-150 to 140-200 sverdrup when compressibility was taken into account, that is, by a factor 1.3-2.3. In the case of horizontal temperature inhomogeneity allowance for pressure when computing sea water density leads not only to an increase in the density value itself but also an increase in the horizontal density gradients, and accordingly an increase in current velocities in the deep layers. Figures 2; tables 1; references 8: 6 Russian, 2 Western.

[148-5303]

UDC 551.465.6

MECHANISMS OF FORMATION OF FINE STRUCTURE OF VELOCITY FIELD OF OCEAN CURRENTS

Moscow OKEANOLOGIYA in Russian Vol 22, No 2, Mar-Apr 82 (manuscript received 20 Jan 81, after revision 23 Jul 81) pp 186-191

ZHURBAS, V. M., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] A series of multiple measurements of vertical current velocity profiles was carried out during the 22d voyage of the "Dmitriy Mendeleev" in the western equatorial zone of the Pacific Ocean at 7°N using an acoustic measurement complex with a cable connection to the ship. The response of the velocity channel was $0.5 \text{ cm} \cdot \text{sec}^{-1}$ and the accuracy in measuring current direction was 3°.

The measurements were made from the drifting ship in a vertical sounding regime each 1-4 hours with a rate of lowering of the instrument of about $0.5 \text{ m} \cdot \text{sec}^{-1}$ in the depth range 20-700 m. In addition, measurements were made of the vertical profiles of temperature, salinity and density in the layer 0-500 m. After ascertaining the u and v velocity components, the fine-structured features of the velocity field with maximum vertical dimensions 16, 32 and 64 m were determined. The data revealed that the amplitudes of inhomogeneities of current velocity in the pycnocline have a tendency to a decrease with an increase in depth, that is, with an attenuation of stratification. A quantitative analysis of this tendency was made by breaking the entire layer down into 9 intervals. The materials reveal that the spectral density of the fine structure of the current velocity field is described by the expression $S_v(m) \sim m^{-3}$, where m is the vertical wave number. The standard deviations of current velocity σ_v varied with depth as $\sigma_v \sim N(z)$ with $N(z) > 10^{-2} \text{ rad} \cdot \text{sec}^{-1}$ (layer of great density gradients, $N(z)$ is the mean profile of the Väisälä-Brunt frequency) and $\sigma_v \sim N^{1/2}(z)$ with $N(z) < 10^{-2} \text{ rad} \cdot \text{sec}^{-1}$ (main pycnocline). The in situ observations revealed features in the fine structure of the current velocity field in the layer of high density gradients which can be attributed both to the internal waves mechanism and to the geostrophic turbulence mechanism. Figures 2; tables 1; references 12: 8 Russian, 4 Western.

[148-5303]

UDC 551.511.6

EFFECT OF SURFACE-ACTIVE SUBSTANCES ON WIND WAVES

Moscow OKEANOLOGIYA in Russian Vol 22, No 2, Mar-Apr '82 (manuscript received 26 Dec 80, after revision 14 Apr 81) pp 192-195

ARKHAROV, A. V., PETRICHENKO, S. A. and PUDOV, V. D., Institute of Experimental Meteorology, Obninsk; Kiev State University

[Abstract] The change in energy exchange in the presence of a surface-active substance is attributable to the depressor effect of these substances and the capacity of their films to extinguish capillary waves. An experimental study of the effect of surface-active substances on wind waves was made in the storm basin of the Black Sea Division, Marine Hydrophysical Institute. Carmidol was used in creating a monomolecular film over the entire area of the basin. Six series of wave measurements were made at different wind speeds. It was found that with low wind speeds the presence of a film totally suppresses the development of waves, whereas at high wind speeds the energy of well-developed waves is less than would otherwise be the case. The presence of a film when high wind speeds prevail favors a more rapid development of waves. The presence of a surface film causes the extinction of capillary waves on both slopes of each wave, resulting in a decrease in tangential friction and therefore a decrease in the intensity of well-developed waves. In the initial period of wave development the extinction of capillary waves on the windward wave slope causes an increase in the normal component of dynamic head and a more rapid increase in wave phase velocity. With an increase in phase velocity the dynamic head

decreases and a state of equilibrium is attained more rapidly than in the absence of a film. The effect of films on the intensity of well-developed waves at high wind speeds, causing a decrease in wave amplitude, results in an additional decrease of the active surface. Figures 2; tables 1; references: 4 Russian.

[148-5303]

UDC 532.5

EXPERIMENTAL INVESTIGATION OF ENTRAINMENT PROCESS IN TWO-LAYER FLUID

Moscow OKEANOLOGIYA in Russian Vol 22, No 2, Mar-Apr 82 (manuscript received 5 Mar 80, after revision 20 May 81) pp 196-203

SHELKOVNIKOV, N. K. and ALYAVDIN, G. I., Moscow State University imeni M. V. Lomonosov

[Abstract] The authors describe a model of a two-layer fluid used in studying the properties of entrainment of a nonturbulent heavy fluid into a lighter mixed layer. The experiment was carried out in an apparatus measuring 710 x 60 x 37.5 cm; the height of the wind tunnel was 11.5 cm; maximum wind velocity was varied from 4 to $6.5 \text{ m} \cdot \text{sec}^{-1}$. The channel was filled with a saline solution (7.5 to 20‰) over which a layer of fresh water was situated. The wind gave rise to a drift current in the upper layer and a compensatory counter-current, with wind waves at the surface. A distinct interface was formed between the mixed and motionless layers. The following parameters were determined: mean wind speed, longitudinal and vertical components of wind velocity fluctuations near the water surface, amplitude and frequency of surface waves, vertical profile of mean current velocity in the mixed layer, vertical distribution of mean water temperature, vertical distribution of mean salinity. The shadow method was used in a photographic survey of eddy formations in the boundary region. It was found that almost all the wind energy imparted to the water flow was dissipated and only a small part (0.1-0.2%) was involved in the entrainment process. It was clear that the theory of an oscillating viscous sublayer (H. A. Einstein and H. Li, PROC. ASCE, J. ENG. MECH. DIV., EM2, 945, pp 1-27, 1956) can be used in describing the entrainment process. The latter is described as follows. Over motionless saline water there was a quasilaminar sublayer whose thickness increased as a result of the operation of viscous forces until it became dynamically unstable. Turbulent eddies in the main flow could cause intensive mixing into which the motionless water was entrained. Because the time of increase of the sublayer during which energy accumulated considerably exceeded the mixing time, the quantity of stored energy was adequate for overcoming the stable interface. The entrainment process was accompanied by powerful surges of saline water into the mixed layer. This process is cyclic in nature. The presented materials demonstrate that the hypothesis of an oscillating sublayer describes one of the possible entrainment mechanisms in a two-layer system with adequate stability. Internal waves do not play a significant role. Figures 6; tables 1; references 12: 6 Russian, 6 Western.

[148-5303]

CORRELATION BETWEEN PRESENCE OF PETROLEUM AND GAS AND ZONES OF SUBDUCTION OF LITHOSPHERIC PLATES

Moscow OKEANOLOGIYA in Russian Vol 22, No 2, Mar-Apr 82 (manuscript received 20 Feb 81, after revision 11 May 81) pp 236-245

SOROKHTIN, O. G. and BALANYUK, I. Ye., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] There are many important corollaries which follow from the theory of tectonics of lithospheric plates which are applicable in the search for petroleum and gas and comprehension of the processes leading to their deposits. The most important of these is that hydrocarbons can be generated in the zones of subduction of lithospheric plates beneath island arcs and the active margins of the continents. The author has already explored this question in a series of investigations (for example, in DOKLADY AN SSSR, Vol 214, No 6, pp 17-24, 1974). It appears that most of the basins situated in the foredeeps of platforms and containing up to 80% of the world reserves of petroleum and gas could have developed due to the migration of hydrocarbons into them from recent and ancient zones of subduction (although other processes may have been involved). These hydrocarbons were formed due to the hydrolysis and thermolysis of organic substances drawn into the subduction zone together with oceanic sediments when enormous volumes of terrigenous and terrigenous-calcareous sediments of the continental slopes and shelves were involved in the advance of island arcs onto the margins of the continents. The coastal sediments usually are the most enriched with organic matter. After discussing the general principles of this process, the article examines the specific cases which illustrate the thesis: Persian Gulf, Venezuela, Algeria, and others. Equipped with a comprehension of this process, geologists are in a position to predict the location of new petroleum and gas provinces. Figures 4; references 25: 21 Russian, 4 Western.

[148-5303]

UDC 533.9

THEORY FOR COMPUTING SIGNAL FLUCTUATIONS IN STRATIFIED MEDIUM WITH RANDOM INHOMOGENEITIES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 2, Jan 82 (manuscript received 3 Aug 81) pp 456-459

MOISEYEV, A. A., Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] Strong fluctuations in the wave field can be described using the Markov (diffusional) approach to study of wave propagation in randomly inhomogeneous media. The diffusional approximation was applied to the case of propagation of a monochromatic wave in a layered medium with macroscale quasi-homogeneous anisotropic fluctuations of the refractive index (a practical example would be sound propagation in an ocean with inhomogeneities caused by internal waves). As a point of departure, in solving the problem the author postulates that there is a known solution (in geometrical optics) for the field of a point source with a given frequency in media with and without random inhomogeneities; then the signal at the reception point can be represented in the form of the sum of signals arriving along known "undisturbed" rays. Assuming further that the distance between ray tubes is greater than the correlation radius of inhomogeneities, the signals arriving along different ray tubes will be statistically independent. The problem solved here therefore essentially involves a determination of the statistical characteristics of signals arriving along each of the ray tubes. The author's contribution is a validating of use of the diffusional approximation for computing fluctuations of some signal parameters in a layered medium with macroscale random inhomogeneities.

References 7: 5 Russian, 2 Western.

[96-5303]

UDC 550.380

OPTIMUM INTERPOLATION OF DATA FROM SEA GRADIENTOMETRIC SURVEYS

Moscow GEOMAGNETIZM IN AERONOMIYA in Russian Vol 21, No 6, Nov-Dec 81 (manuscript received 11 Jun 80) pp 1081-1086

ZOLOTOV, I. G. and ROZE, Ye. N., Leningrad Division, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences

[Abstract] Important unsolved problems in the gradientometric method for study of the earth's anomalous magnetic field (EAMF) are discussed. The data from such a survey constitute the totality of vector field values, the EAMF gradient in different directions. It is essential that these data be processed for their reduction to a single direction or two mutually perpendicular

directions. The problem can be solved by optimum interpolation, such as employed in processing magnetic surveys. After defining a model of a gradientometric survey, it is shown how the optimum interpolation method can be applied. Expressions are derived which in a linear approximation give an expansion of the cross-correlation function of the field gradient; the coefficients of this expansion are functions of the direction cosines for the calculated run and can be defined as both the conditions for carrying out the survey and information on the statistical properties of the trajectory of motion of the sensors. The derivatives in the key formula can be regarded as either derivatives of the field autocorrelation function along the coordinate axes or as the elements of the field gradient correlation matrix along these axes. If information on the statistical characteristics of the trajectory of motion of the sensors is not available, the advantages of the gradientometric survey method are considerably compromised. If measurements of the parameters of the actual trajectory are not made during the survey but there is basis for assuming that the statistical properties of the trajectory are the same over the entire survey area, the algorithm given here will increase the final accuracy. Figures 1; references 7: 6 Russian, 1 Western.

[97-5303]

UDC 551.465

MACROSCALE CIRCULATION OF BAROTROPIC OCEAN WITH PARAMETERIZATION OF SYNOPTIC EDDIES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 6, Feb 82 (manuscript received 2 Jul 81) pp 1485-1490

DANILOV, A. I., IVCHENKO, V. O. and NIKOLAYEVSKIY, V. N., Arctic and Antarctic Scientific Research Institute, Leningrad

[Abstract] If synoptic eddies are not taken into account in models of macroscale circulation of a barotropic ocean it is impossible to obtain a correct representation of oceanic circulation. The authors have formulated a model which does take them into account. After writing the equations for macroscale circulation and approximating the ocean as a doubly connected region, a solution was found for the problem of setting-in of a barotropic ocean of variable depth with parametric allowance for movements at a synoptic scale. Figure 1 shows the distribution of the stream function without allowance for synoptic eddies, whereas in Fig. 2 these were taken into account. Comparison of the two figures reveals that there are no global changes in circulation, but there is a tendency in Fig. 2 to an increase in the volumetric flow of anticyclonic circulations in the North Atlantic and the northern Pacific; there is an increase in the volumetric flows of similar circulations in the southern hemisphere; in the equatorial zone the total transport in circulation elements of the northern hemisphere increases, but similar circulations in the southern hemisphere are somewhat weakened; minimum quantitative changes in total

transport are observed in Antarctic Ocean currents. In all these regions there is a redistribution of momentum resulting in an intensification of the jet character of currents. Figures 2; references 15: 10 Russian, 5 Western.
[119-5303]

UDC 551.464

DECREASE IN POTASSIUM CONTENT AND K/Cl RATIO IN KUROSHIO: RANDOM OBSERVATION OR PHENOMENON

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 4, Feb 82 (manuscript received 16 Oct 81) pp 838-842

SOYFER, V. N., BYCHKOV, A. S. and IL'ICHEV, V. I., corresponding member, USSR Academy of Sciences, Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok

[Abstract] Studies of the spatial distribution of potassium in the upper 500-1000 m layer in the western Pacific revealed K variations in the range 2-3%; the work was done along 141°E in the latitude range 0-35°N and southward along 142.5°E, the region where the Kuroshio Current is formed. The distribution of K and the K/Cl ratio in this area was mapped; the two parameters were 390/mg kg and 0.0203 and 400 mg/kg and 0.0206 for the Kuroshio area and the Pacific Ocean as a whole respectively. Tabulated data indicate the reliability of identification of Kuroshio waters on the basis of K and K/Cl values; the reliability is in the range 0.999-0.99. An attempt was made to trace this transport from the zone of generation to the zone of transformation and dissipation of the Kuroshio. Different hypotheses which might explain the observed differences were explored. It is clear that these indices will make it possible to trace the transport, transformation and dissipation of water masses. It is also clear that the impoverishment of sea water with potassium is attributable to the mechanism of vertical and lateral exchange. Figures 3; tables 1; references 10: 5 Russian, 5 Western.

[104-5303]

SPECTRUM OF NATURAL OSCILLATIONS IN WORLD OCEAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 4, Feb 82 (manuscript received 4 Jun 81) pp 974-977

GOTLIB, V. Yu. and KAGAN, B. A., Leningrad Division, Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] In an earlier study (DAN, VOL 252, No 3, p 725, 1980) the authors determined the resonance periods and relative amplitudes of level fluctuations at five points in the world ocean and on that basis postulated the possibility of resonance excitation of semidiurnal and diurnal tides. Continuing this line of research, the authors made an analysis of the spectrum of natural oscillations in the ocean. Postulating that the source of excitation of these oscillations is an arbitrary initial disturbance, it is demonstrated that the frequencies of the characteristic oscillations, with and without allowance for the "load" and "self-attraction" effects, do not differ greatly from one another; although these effects cause a decrease in the frequency of natural oscillations, they can be neglected at least in the semidiurnal frequency range. The spectrum of natural oscillations, shown in Fig. 1, reveals that oscillations of a barotropic ocean combine surface gravitational waves and barotropic Rossby waves. It is difficult to identify gravitational modes in the high-frequency spectral region because they are closely spaced, whereas in the low-frequency region, where Rossby waves for the most part are grouped, the identification of individual gravitational waves presents no difficulties. The maximum period of gravitational oscillations is 114.14 hours. The figure shows that the spectrum of natural oscillations contains more than 30 energetically significant modes; the parameters of these oscillations are summarized in a table. Figures 1; tables 1; references 6: 4 Russian, 2 Western.

[104-5303]

MESOSCALE EDDY STRUCTURE OF ARCTIC BASIN WATERS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 5, Feb 82 (manuscript received 20 Mar 81) pp 1250-1252

BOGORODSKIY, P. V., GUSEV, A. V. and ZUBKOV, L. I., Arctic and Antarctic Scientific Research Institute, Leningrad

[Abstract] Until recently the existence of mesoscale eddies in the Arctic Basin has been based on slim evidence. This article gives the results of investigations of the eddy structure of Arctic Basin waters based on a survey of the temperature and speed-of-sound fields in a polygon measuring 125 x 125 km with measurements to a depth of 250 m with a discreteness of 5 m. The same fields were measured simultaneously at the "Severnyy Polyus" base station to a depth of 500 m. Closed formations which can be traced at all horizons are clearly manifested in the horizontal sections of both fields at all horizons. The sameness of the mesoscale structures in both fields indicates a common mechanism causing deformation of these fields. Within the polygon there were three cyclonic (Zn_1-3) and two anticyclonic (AZn_1-2) mesoscale eddies. The degree of expression of both fields is greater for cyclonic formations. The influence of eddy formations increases with depth. The effective radius of mesoscale eddies and the distances between their centers average 12-25 and 30-60 km respectively. Particular attention is given to mesoscale eddy Zn_2 . When the drifting station intersects the zone of influence of Zn_2 disturbances appear in the sound and temperature fields which can be interpreted as a manifestation of anticyclonic structures of a lesser spatial scale (1.7-2.7 km), but they are not observed when the station is at the center or at the periphery of the eddy formation. A mesoscale eddy formation as structural elements contains eddies of a lesser spatial scale which probably have their own structure. The existence of such anticyclonic structures can be interpreted as a manifestation of instability of mesoscale eddy movements. Figures 3; references 6: 3 Russian, 3 Western.

[109-5303]

GEOCHEMICAL CHARACTERISTICS OF FERROMANGANESE NODULES AND AMBIENT SEDIMENTS
OF SOMALI AND ARABIAN NODULE FIELDS IN INDIAN OCEAN

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 42, No 2, Mar-Apr 82 (manuscript
received 20 Jul 81) pp 50-56

SHNYUKOV, Ye. F., YANCHUK, E. A., SMIRNOV, B. I. and ORLOVSKIY, G. N.,
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Academy of Sciences

[Abstract] Multistratum nodule fields were discovered during the 19th voyage
of the scientific research ship "Akademik Vernadskiy" in the Indian Ocean in
the Somali and Arabian Basins. At several stations studies were made of the
distribution of chemical elements and their paragenetic associations were de-
termined in ferromanganese nodules and in the surrounding oozes. The mineral
composition of the samples was ascertained and the results of statistical
processing of the results of chemical and spectral analyses are presented.
Three groups of elements stand out: those accumulating in nodules -- Mo, Pb,
Co, Ni, Fe, V, La, Cu, Mn, P; those accumulating in sediments -- Ca, Corg, Sc,
Al, Si, Ba, Mg; those with contents not differing significantly in nodules and
sediments -- Be, Ti, Zr, Y, Yb. The comparison of the contents of elements
in oozes and nodules yielded valuable information on the nodule-forming
process. The investigations made it possible to compute the coefficients of
concentration of the elements in the nodules. The following series of intensity
of accumulation of elements in the studied nodules was established: Mo > Pb >
Co > Ni > Fe > V > La > Cu > Mn > P. The study revealed different forms of
presence of Fe and Mn in oozes, with Fe being present primarily in silicates;
the biogenous factor plays an important role in Mn accumulation. In the
nodule-forming process Fe is segregated in the form of the amorphous phase,
whereas Mn in the nodules associates with Cu, Ni, Ba and Pb. Figures 3;
tables 2; references 18: 12 Russian, 6 Western.

[135-5303]

SORPTIONAL UPTAKE OF MANGANESE BY OCEANIC BOTTOM SEDIMENTS AND COMPUTATION OF FERROMANGANESE NODULE GROWTH RATE FROM MANGANESE SORPTION RATE

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 42, No 2, Mar-Apr 82 (manuscript received 20 July 81) pp 56-64

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[Abstract] A study was made of the sorptional uptake of Mn by sediments on the sea floor, as well as the desorption of Mn from bottom sediments into ocean water, and calculation of the rate of growth of nodules on the basis of the rate of Mn sorption as a function of its concentration, temperature and size of nodule. By use of the tagged atoms method the sorptional uptake was studied in diatomaceous ooze, calcareous sediments and abyssal red clay raised from the Pacific floor on the 9th voyage of the "Dmitriy Mendeleyev." The laboratory procedures are fully described. By calculations and deduction it was found that the rate of nodule growth increases by a factor of 3.6 with a temperature change from 2 to 30°C, and thus shallow-water nodules, forming in warm waters, should increase in size more rapidly than deep-water nodules. As the nodule increases in radius the rate of its growth decreases (for example, with an increase in the radius of the nodule from 0.25 to 5 cm the rate of growth decreases by a factor of 1.5). Since the Mn concentration in sea water varies, there are no constant rates of nodule growth. With a change in volcanic activity, hydrological and other factors the Mn concentration varies. Sorption processes play a significant role in the forming of Fe-Mn nodules and the kinetics of Mn sorption confirms and to some extent explains the discrepancies reported in the literature. Figures 5; tables 2; references 15: 12 Russian, 3 Western.

[135-5303]

EVALUATING POSSIBILITIES OF FERROMANGANESE NODULE FORMATION BY IRON BACTERIA

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 42, No 2, Mar-Apr 82 (manuscript received 20 Jul 81) pp 73-77

LAZURENKO, V. I. and KIRYUKHIN, V. G., Institute of Geological Sciences, Ukrainian Academy of Sciences; Marine Hydrophysical Institute, Ukrainian Academy of Sciences

[Abstract] As early as 1836 it was postulated that iron bacteria participate in the formation of iron ores, but this has never been totally demonstrated. The authors have investigated the possibility of formation of ferromanganese nodules in the ocean by such bacteria. The evidence indicating the validity of the biological hypothesis includes the fact that in nature there is a group of microorganisms accelerating the oxidation of iron and manganese. Some species of organisms release hydrogen peroxide as a product of metabolism which under the influence of a catalase is transformed into a strong oxidizer. The rate of oxidation of iron and manganese by iron bacteria is greater than the rate of abiogenous oxidation. Some iron bacteria form colonies and overgrowths. Nodules have been grown by means of bacteria. These and other facts are an indirect proof of the biological origin of ferromanganese nodules. A direct proof is the presence of iron bacteria in the nodules. Electron microscope investigations indicated that iron bacteria are present in the composition of the nodules. There is a direct dependence between the degree of mineralization and the oxygen content in the water and a dependence between the chemical composition of Fe-Mn nodules and the chemical composition of water. This neither confirms nor refutes the biological origin of ferromanganese ores because iron bacteria live only in the oxygen zone and their number is directly proportional to the oxygen content in the water. It is still premature to attribute the formation of ferromanganese nodules exclusively to the activity of iron bacteria, but the microbiological factor in ore formation certainly cannot be neglected. References 29: 22 Russian, 7 Western.

[135-5303]

CARIBBEAN SEA FERROMANGANESE NODULES AND SOME CHARACTERISTICS OF THEIR FORMATION

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 42, No 2, Mar-Apr 82 (manuscript received 20 Jul 81) pp 78-82

CHUGUNNYY, Yu. G., Institute of Geological Sciences, Ukrainian Academy of Sciences

[Abstract] Evidence of formation of ferromanganese nodules was discovered at virtually all stations during bottom sampling in straits in the Caribbean: Windward, Mona and Anegada Passages and Saint Lucia Channel. Mass concentrations of these nodules were discovered in the bottom sediments, especially in the Windward and Anegada Passages; this was the first such discovery in the Caribbean. Due to strong currents bottom sediments are highly discontinuous. In such areas thin crusts and films of Fe-Mn composition occur on the surface of thin branching corals, on gravelly grains of volcanic and sedimentary rocks and on the bones of sea animals. It was possible to define different stages in the formation of such formations. The most common structures are: microgranular, lumpy, platy, film, clastic, globular. They also differ with respect to particle size, texture, habit of particles or sculptured surface elements. The principal rock-forming components are Fe_2O_3 and MnO , their content being 19.55-24.33 and 23.60-25.80%; there is a high content of hygroscopic and constitution water, 16.76-15.20 and 18.40-17.00% respectively. The nodules contain phosphates and sulfates, but no CO_2 and C. Radiocarbon studies indicate that the formation of a ferromanganese crust with a thickness of 0.1 mm requires about 22,000 years. Fe-Mn nodules evidently can be formed only in zones of prolonged contact between the sea floor and deep waters with low temperature and low salinity enriched with oxygen, provided that the rates of their movement ensure the minimum possible precipitation of bottom sediments. Nodule formation is closely related to the metabolism of bottom macro- and microorganisms and is determined by the depths of straits, intensity of water exchange, physical and chemical parameters of deep North Atlantic waters and possible receipt of Mn with underwater exhalations. References 12: 11 Russian, 1 Western.

[135-5303]

MORPHOMETRY OF FERROMANGANESE NODULES IN INDIAN OCEAN

Kiev GEOLOGICHESKIY ZHURNAL in Russian Vol 42, No 2, Mar-Apr 82 (manuscript received 20 Jul 81) pp 82-85

KACHANOV, N. N., Institute of Geological Sciences, Ukrainian Academy of Sciences

[Abstract] A study was made of the morphometry of more than a thousand samples of ferromanganese nodules dredged from the bottom at eight geological stations in different parts of the Indian Ocean during the 19th voyage of the "Akademik Vernadskiy." The material was collected from the slopes of the Arabian Sea-Indian Ocean midoceanic ridge and from the floor of the Central, Arabian and Somali Basins. Work in each of these areas is described. The morphometric diversity of the ore samples suggests a cyclic nature of the formation of Fe-Mn nodules. The predominant forms of these nodules were very close to geometrical, the average size being 40 mm. Among all the studied samples there was a predominance of formations with a rough, uneven surface created by micro-nodules of different size. There was a regular distribution of ore formations in small depressions or pockets. It appears that the total quantity of ore matter for the Arabian Sea-Indian Ocean ridge is dependent primarily on the rate of entry of endogenous material into the bottom layer of the ocean. The investigations revealed a great diversity in the nature of the local and areal deposition of ore material, size, shape and anisometry of the samples, all this indicating unquestionable morphogenetic differences in Fe-Mn nodules in different polygons. This sort of information is a prerequisite for designing and selecting appropriate apparatus for the collection of ferromanganese nodules and raising them to the surface for research and commercial purposes. References: 3 Russian.

[135-5303]

REMOTE MEASUREMENTS OF LEVEL SURFACE IN STUDIES OF OCEAN SYNOPTIC VARIABILITY

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 18, No 1, Jan 82 (manuscript received 28 Oct 80) pp 60-69

NELEPO, B. A., PROTSENKO, I. G., TIMCHENKO, I. Ye. and YARIN, V. D., Marine
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[Abstract] The level surface of the ocean is one of its most important characteristics because in integral form it reflects dynamic conditions in the atmosphere, water thermohaline structure, tidal variations, tsunamis and other such phenomena, which leave their trace in deviations of ocean level from the sea geoid. Satellite altimetry is effective in solving the problem and already makes it possible to measure level fluctuations in the open ocean with an accuracy ± 20 cm. The authors apply satellite data on the ocean level for investigating variability of oceanological fields at synoptic scales. The dynamic-stochastic approach to analysis of ocean fields was formulated in a monograph by B. A. Nelepo and I. Ye. Timchenko (SISTEMNNYE PRINTSIPY ANALIZA NABLYUDENIY V OKEANE, Kiev, Naukova Dumka, 1978, 222 pages). Such a model makes it possible to adapt converted field values to measurements successively received in an ocean experiment. In order to carry out the numerical experiments with remote level measurements use was made of a special method for the assimilation of satellite data in the dynamic-stochastic model. The "true" level field and the density field at different levels were simulated on an electronic computer. Temperature and salinity measurements in the POLYMODE polygon were used in approximating the model results to real ocean fields. After reviewing the general equations of the dynamic-stochastic model, the hydrodynamic and stochastic parts of the model are examined in greater detail. Simulation of the transit of satellites over the POLYMODE polygon revealed the effectiveness of this method in studying synoptic variability of the ocean. The method for measuring ocean level and its variations outlined in this article can be extremely effective in monitoring ocean state. Figures 5; references 11: 7 Russian, 4 Western.

[103-5303]

MODEL OF VERTICAL STRUCTURE OF TURBULENT LAYERS IN OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 18, No 1, Jan 82 (manuscript received 15 Oct 80, after revision 25 May 81)
pp 70-77

LOZOVATSKIY, I. D., Institute of Oceanology, USSR Academy of Sciences

[Abstract] A system of semiempirical equations for the hydrodynamics of a turbulent boundary layer can be used in modeling turbulence in a density-stratified ocean. For closing this system use has been made of different hypotheses concerning the relationship between the coefficients of turbulent exchange and the parameters of turbulent and mean movement. The author earlier (OKEANOLOGIYA, Vol 19, No 6, pp 982-991, 1979) derived a dependence between the intensity of turbulence, its external scale and the Richardson number which is suitable for closing this system. It is applied in this paper in solving a system of equations modeling the vertical distribution of fluctuation characteristics in a turbulent layer. A formula is derived which makes it possible to evaluate typical thicknesses of turbulent layers in the seasonal and main thermocline and also to evaluate the thickness of the upper quasihomogeneous layer. Even within the framework of a very simple stationary problem for a layer with constant τ , q_T and q_S fluxes the proposed scheme makes it possible to obtain a number of important characteristics of the field of ocean turbulence. An adequate description of the dynamics of macroscale turbulent formations and investigation of formation of the vertical profiles of temperature, salinity, density and mean current velocity requires solution of the nonstationary problem with allowance for Coriolis force in the equations of motion and representative experimental data are needed. Figures 2; tables 1; references 20: 17 Russian, 3 Western.

[103-5303]

INFLUENCE OF MACROSCALE MOVEMENTS ON PROPAGATION OF SHORT INTERNAL WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian
Vol 18, No 1, Jan 82 (manuscript received 27 Oct 80, after revision 11 Feb 81)
pp 79-87

VORONOVICH, A. G. and GONCHAROV, V. V., Institute of Oceanology, USSR Academy
of Sciences

[Abstract] Macroscale movements, such as long internal waves and Rossby waves, exert an influence on the propagation of short internal waves. These movements result in spatial and temporal variations of the "Vaisala" frequency and create horizontal currents. The influence of macroscale movements on the propagation of packets of short internal waves was investigated by the authors. It was found that if the characteristic scales of these movements considerably exceed the lengths of the short internal waves the propagation of the packet in the field of macroscale movement can be studied in the approximation of geometrical optics. Particular attention is given to a case when the macroscale movement is generated by a long internal wave and also a Rossby wave. The influence of macroscale movements on the dispersion characteristics of internal waves is also considered. The results of specific numerical computations are given. The calculations revealed that the amplitude and length of the short waves in the course of propagation can vary by several times and in some cases by an order of magnitude. Figures 4; references: 3 Russian.
[103-5303]

TERRESTRIAL GEOPHYSICS

UDC 530.344+550.347/.348

SEISMIC HOLOGRAPHY AND UPPER MANTLE VERTICAL INHOMOGENEITY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 5, Apr 82
(manuscript received 24 Nov 81) pp 1102-1105

NIKOLAYEV, A. V., TROITSKIY, P. A. and HUSEBYE, E. S. (Norway), Institute of Physics of the Earth imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] The results of application of holographic concepts at a seismological scale are given, as illustrated by data from the NORSAR seismic group (see H. Bungum, et al., GEPHYS. J. ROY. ASTR. SOC., Vol 25, 1971, where this research project is described). Seismic holography is distinguished in a number of ways from optical and acoustic holography, such as: complex structure of the investigated medium, the extent of the inhomogeneities is small, the area of registry of the wave field is lesser by a factor of 10^6 than in optics and there is a large wave field discretization interval. These peculiarities are clear in the described investigation, which discusses formulation of the specific investigation, interpretation of results and quality criteria used for the restored image of the inhomogeneities. An ultrasonic model experiment preceded the processing of field data. The epoxy resin model measured $50\lambda \times 50\lambda \times 80\lambda$ and the inhomogeneity was an aluminum cross (length and width of arms 12λ and 2λ respectively) at a distance of about 20λ from the model surface. The distance between the source of ultrasonic oscillations (source diameter 12λ) and the cross was 30λ . Using this model it was possible to simulate the arrangement of NORSAR sensors. The model is described in detail and the results are presented. A series of figures illustrate the image constructed for the three azimuths and three depths characterized by the strongest scattering properties; a comparison with time nonclosures is given. Six regions of anomalous intensity were revealed which indicated that the lithosphere in southern Norway has a well-expressed inhomogeneity of scattering properties. Figures 2; references 9: 2 Russian, 7 Western.

[146-5303]

ONE MATCHED FORMULATION OF INVERSE PROBLEMS IN SEISMICS AND GRAVIMETRY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 261, No 5, Dec 81
(manuscript received 24 Aug 81) pp 1086-1090

ALEKSEYEV, A. S., corresponding member, USSR Academy of Sciences, and BUBNOV, B. A., Computation Center, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] In regional investigations of crustal structure, in addition to joint use of seismic sounding data and data obtained by the refracted waves method, it is possible to integrate data from areal gravimetric investigations covering the area through which the seismic profiles run. Using seismic sections of the crust along these profiles as reference sections and using the correlations between the thickness and relief of individual layers, on the one hand, and gravity field anomalies along the profiles, on the other, these correlations are extrapolated to a more extensive region and crustal structure is predicted over the entire studied area. However, the combining of seismic and gravimetric investigations is defective in a number of ways. For example, the integration of data fails to take into account additional unique information on the medium contained in the data obtained by the other method, although it is clear that the elastic characteristics and density of the medium exert a joint influence on the seismic and gravity fields. At the same time these characteristics are incorporated as coefficients in the equations for the seismic process, and one of them, density, enters into the equation for gravitational potential. Therefore, with the combining of the seismic and gravimetric methods it seems possible and necessary to use a quantitative formulation of the joint inverse problem of simultaneous determination of the elastic characteristics and the density of the medium on the basis of the totality of seismic and gravimetric measurements. A model problem is examined here in great detail as a demonstration of the possibilities of such an approach and the formulated problem is solved. References: 1 Russian.

[101-5303]

GEOMETRIC CENTER LINES METHOD FOR EVALUATING EARTHQUAKE EPICENTER POSITION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 261, No 5, Dec 81
(manuscript received 10 Jul 81) pp 1095-1098

POPLAVSKIY, A. A. and TOTOK, A. G., Sakhalin Multidiscipline Scientific Research Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Novoaleksandrovsk Sakhalinskaya Oblast

[Abstract] A new method has been developed for determining the position of an epicenter. In this method it is sufficient to know only the sequence of increase in distances from the epicenter to a particular group of stations. This sequence is easily established from observations if it coincides with the sequence of increase of the corresponding times of the first arrivals of seismic waves. This is correct under the condition that the earth's matter is transversally homogeneous and isotropic. The error in this method is dependent on the number n and location of stations and decreases without limit with an increase in n . The problem is formulated as follows. "Assume that on a sphere approximating the earth's surface the position of n seismic stations is stipulated and these are numbered in the sequence of the increase in epicentral distances. It is necessary to determine the region of admissible epicenters at the surface of a sphere, the distances from each point of which to a particular group of stations increase in one and the same stipulated sequence." The procedures for ascertaining the region of admissible epicenters are outlined in detail, the key feature being the use of the geometric center lines method. The described approach makes it possible to achieve a virtually limiting evaluation of the position of an epicenter in any region of the earth despite use of a relatively small number of stations ($n \approx 100$). The actual accuracy in determining an epicenter is dependent on the proper arrangement of stations with respect to the arrival times of seismic waves and the correspondence of this arrangement to the actual sequence of increase in epicentral distances. An algorithm was developed for the described method and was used in carrying out two variants of control computations. The materials presented here indicate that the proposed method can be used successfully in the group processing of adequately strong earthquakes ($M \geq 4.5$) when data from all stations in the Far East are used (and in some cases, data from remote stations). Figures 1, references: 4 Russian.

[101-5303]

UDC 550.831

SOLUTIONS OF INVERSE GRAVIMETRIC PROBLEMS BY ITERATION METHODS

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR: NAUKI O ZEMLE in Russian
Vol 34, No 5, Sep-Oct 81 (manuscript received 25 May 81) pp 68-74

OGANESYAN, S. M., Order of Red Banner of Labor Institute of Geophysics and
Engineering Seismology, Armenian Academy of Sciences

[Abstract] Application of the mathematical modeling method in the interpretation of gravity anomalies rests on the theory of the inverse problem in gravimetry. Different formulations of the inverse problem are possible within the framework of the mathematical modeling method (depending on the extent of geological-geophysical study of the investigated area). These include a formulation in a class of finite-dimensional parametric models and a formulation in a class of distribution of densities in some functional space. Both of these formulations are examined in depth, with full consideration of their strengths and weaknesses, and solutions are obtained. Programs are written for solution of the inverse problem. These algorithms were convenient for studying geological features with a vertically layered and a horizontally layered structure on the basis of gravimetric data. The programs were employed in interpreting gravimetric data along a profile in Armenia for determining the contact surface between the sedimentary cover and the crystalline basement, detecting the probable horizontal density boundaries in the upper part of the crust and defining vertical boundaries in the earth's crust. The results indicated great possibilities for use of stable algorithms when studying the structure of the earth's crust and upper mantle by the gravimetric method. References:

21 Russian.

[127-5303]

UDC 629.195:551.24(571.14)

LINEAMENTS DISCRIMINATED ON TELECOSMIC IMAGES OF CENTRAL SIBERIA, THEIR POSSIBLE GEOLOGICAL NATURE

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian
No 3, Mar 82 pp 30-35

NAUMKIN, A. N., Moscow State University imeni M. V. Lomonosov

[Abstract] Television space photographs and structural, geophysical and morphometric diagrams for a part of the Tungusskaya syneclyse were compared. The "Meteor" photographs (at 1:2 000 000) and the maps covered an area of about 20 000 km². The map of lineaments (structural lines) plotted from the TV images is reproduced as Fig. 1. These lines are oriented NE-SW and NW-SE; the principal faults in the basement are oriented in the same directions and the distance between them averages about 100-150 km. Most of the lineaments have

a NW-SE orientation and are traced for 200-300, sometimes 500 km. Comparison of photos and maps revealed that virtually all the interpreted lineaments were already present on geological-geophysical maps and diagrams; about half of the linear structures are reflected on maps of the Mohorovicic discontinuity and maps of vertical dissection of relief. It is clear that the lineaments are reflections of structural inhomogeneities of the crystalline basement and the Moho in the upper horizons of the crust activated during the most recent tectonic stage. These lineaments were formed due to crustal dilatation without significant horizontal and vertical displacements. Figures 2; references: 8 Russian.

[132-5303]

UDC 629.195:551.24

ANNULAR STRUCTURES IN EARTH'S CRUST: THEIR SIGNIFICANCE FOR TECTONICS AND METALLOGENY

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 3, Mar 82 pp 14-21

MIKHAYLOV, A. Ye., Moscow Geological Prospecting Institute imeni S. Ordzhonikidze

[Abstract] This is an overall review of the known facts concerning annular structures of all scales observed in the earth's crust and the hypotheses advanced to explain them. These structures can be divided into two classes: less than and more than 90 km in diameter. Those less than 90 km evidently have a volcanic-plutonic or inversion-gravitational origin. The annular structure of the first type is attributable to the circular configuration of volcanic structures and the arrangement of many relief elements around centers of eruption. The second type is associated with regions of crustal subsidence. Some are associated with salt domes or arched uplifts in subsalt horizons over projections of the basement, whereas others are attributable to the rising of large granite complexes. The origin of structures with a diameter greater than 90 km is still unclear, but it is usually believed that they are of ancient origin. Many of them are not associated with elements of geological structure of the upper parts of the crust. A widely held opinion is that large annular structures reflect the paleorelief of the planet existing 3.5-4 billion years ago and are similar to the impact-volcanic relief of other planets. Some contend that they reflect deep "energy centers" in the asthenosphere and the structures themselves represent the sites of penetration of molten mantle masses into the crust. Quite uncommon are gigantic annular structures (diameter more than 250 km) arising during destruction of the granite-metamorphic base of the crust, its fracturing and creeping of growing uplifts of mantle matter toward the periphery. Some annular structures are associated with mineral deposits, including petroleum and gas. Figures 1.

[132-5303]

UDC 550.348.436

RELATIONSHIP BETWEEN NATURAL AND TECHNOGENIC FLUID DYNAMICS AND EARTHQUAKES

Moscow SOVETSKAYA GEOLOGIYA in Russian No 2, Feb 82 pp 116-124

PETRENKO, V. I., Northern Caucasus Scientific Research Institute of the Gas Industry

[Abstract] The author reviews the literature on the mechanism whereby earthquakes exert an influence on the dynamics of fluids in petroleum deposits and ground water, as well as the feedback, that is, how technogenic fluid dynamics and geofluid dynamics exert an influence on seismic activity. The author shows that even during early stages in earthquake preparation there are geochemical and regime anomalies in ground water and deposits of fluid and gaseous minerals, a highly important earthquake precursor. These forerunner geochemical anomalies are caused by the expulsion of fluids from noncollector rocks into permeable strata. At the same time, in hydrocarbon (especially gas) deposits there are well-expressed gravity anomalies due to crustal stresses. Changes in crustal stress caused by working of petroleum, gas and ground water deposits can be comparable in effect to tectonic phenomena and under certain conditions can cause an earthquake or contribute to such an event. During all stages in earthquake development geohydrodynamic systems contribute to disruption of crustal equilibrium. Study of these and other phenomena is essential in developing schemes for predicting the time and place of seismic events. Many of these phenomena can be modeled in the laboratory. References 12: 11 Russian, 1 Western.

[125-5303]

UDC 528.711.1(203):550.836.2:551.243(574.3)

THERMAL AERIAL SURVEY IN STUDY OF TECTONIC STRUCTURES IN ARID ZONE

Moscow SOVETSKAYA GEOLOGIYA In Russian No 12, Dec 81 pp 107-116

PETROV, A. I. and SHILIN, B. V., "Aerogeologiya" Scientific-Production Association

[Abstract] The possibilities of application of a thermal IR aerial survey in structural geology are explored. The best illustrative materials for such an examination are those available for an arid zone with good surface exposure or the presence of a thin, unconsolidated surface layer. The principal criteria to be used in such studies and the peculiarities of the image on thermal aerial photographs are outlined. Special attention is given to the means by which it is possible to interpret the most common structures controlling mineralization in this region, such as dislocations (faults of different types), radial-annular complexes, arched uplifts and zones of compression and dilatation.

Three photographs from such a survey are used for graphic and textual interpretation; these were taken in the Northern Balkhash and Central Kazakhstan regions. The presented materials clearly show that an arid-zone thermal IR survey is effective in detecting and classifying local and regional tectonic structures, making it possible to detect indicators not present on other sources. The contrast and morphology of nonuniformities in the thermal field make possible discrimination of a wide range of structures and complexes. Much more work must be done along these lines, the possibility of developing new methods for discovering zones of mineralization fully justifying such investigations. Figures 3; references: 15 Russian.
[126-5303]

UDC 550.84

PERIODIC CHANGES IN GAS CONCENTRATIONS IN DAGESTAN THERMAL WATERS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 6, Feb 82 (manuscript received 21 Oct 81) pp 1351-1353

SARDAROV, S. S., SARDAROV, S. S. (Jr.) and MANTIKOV, A. B., Geology Institute and Institute of Geothermal Problems, Dagestan Affiliate, USSR Academy of Sciences, Makhachkala

[Abstract] An effort is made to explain the stable periodic changes of helium and argon in natural gas not associated with seismogenic processes and at the same time ascertain the spectral composition of stable changes in the concentrations of hydrogen, helium, nitrogen and methane in ground water. These gases were measured simultaneously with chromatographs at the mouth of a bore-hole in Dagestan each hour. Spectral analysis of variations of gases revealed the presence of different frequencies and periodograms were constructed. Errors in determining period were 12% and errors in ascertaining amplitudes of variations were 6-10%. The analysis revealed a complex harmonic structure of variations in concentration. A table gives the results of two series of observations. Stable variations with periods of about 8, 12, 15 and 24 hours are typical for all gases; some gases have only certain periodicities. The diurnal and semidiurnal components are associated with earth tide waves, but the periods of 8 and 15 hours cannot be explained. Another table gives the amplitudes of the stable geochemical periodicities. Under calm seismic conditions the mean concentrations (volume percent) were: nitrogen -- 57.7, hydrogen -- 0.005, methane -- 24.7, helium -- 0.03. The study confirmed the presence of stable geochemical periodicities in natural gas deposits and thermal waters. Tables 2; references 6: 5 Russian, 1 Western.

[119-5303]

UDC 550.34:551.24

GENTLY SLOPING TECTONIC CONTACTS AND CRUSTAL STRUCTURE OF UKRAINIAN SHIELD
ACCORDING TO DEEP SEISMIC SOUNDING DATA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 6, Feb 82 (manuscript
received 1 Jul 81) pp 1440-1442

SARKISOV, Yu. M.

[Abstract] The seismic sections of the Ukrainian shield obtained in this study reveal important information on gently sloping tectonic contacts casting new light on the deep structure and history of crustal development. These tectonic contacts in some cases pass through the entire crust and sometimes intersect a medium relatively uniform in its elastic properties where reflected waves cannot develop. Figure 1 is a crustal section of the shield interpreted with allowance for the gently sloping tectonic contacts and showing their relationship to other structures. This seismogeological section in turn helps to explain the nature of these significant tectonic contacts. The interpretation given here considerably clarifies the nature of the principal seismic horizons; it is clear that the shield has a more complex character than believed earlier. For example, the seismic horizon C here is an interface between "granite" and "basalt" layers of two generations, early and late, and the different variants of contacts of these layers explain the difference in elastic properties of the C horizon characteristic of the shield; much the same holds true for the M discontinuity. Figures 1; references: 3 Russian.

[119-5303]

UDC 622.011.4

FORMING OF SEISMIC EARTHQUAKE PRECURSORS IN STRATIFIED MEDIUM

Alma-Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 1, Jan 82 pp 9-13

YERZHANOV, Zh. S., academician, Kazakh Academy of Sciences, and POZDNYAKOV, A. V., candidate of physical and mathematical sciences

[Abstract] This report was presented at the Fourth Congress on Theoretical and Applied Mechanics, Varna, Bulgaria, 14-18 September 1981, and represents a continuation of work published earlier by the authors (FIZICHESKIYE PROTSESSY V OCHAGAKH ZEMLETRYASENIY, Moscow, "Nauka," p 123, 1980). In earthquake prediction it is important to know that prior to strong events the ratio of travel times of longitudinal and seismic waves first decreases and then is restored to the background level; the duration of this baylike variations can be several years. Accordingly, the authors have sought to define the physical mechanism of so important a precursor. The investigation was made using the same laboratory model as in the earlier study; they employed a rectangular grid with a

system of straight collinear slits simulating attenuated zones of contacting layers. The model was exposed to a variety of increasing compressive and dilatational forces which revealed that the velocities of both transverse and longitudinal waves increase with an increase in compressive forces; the minimum values of the latter correspond to a direction normal to the plane of the slits, whereas the ratio of velocities of longitudinal and transverse waves increases to the greatest degree in directions parallel to the plane of the slits. Compressive forces exert a great influence on the velocity of transverse waves, which in decreasing with an increase in the forces, can attain 20% of the initial background levels. Variations of the ratio of velocities are characterized by a bay and are fully determined by changes in the velocity of transverse waves. The velocities of transverse waves and the ratio of velocities of longitudinal and transverse waves are of the greatest prognostic importance.

References: 2 Russian.

[110-5303]

UDC 539.3+551.21+550.31

COMPUTING SEISMIC SOURCE WITH STIPULATED RADIATION DIRECTIVITY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 4, Feb 82 (manuscript received 21 Jul 81) pp 831-834

BABESHKO, V. A., GLUSHKOV, Ye. V. and ZINCHENKO, Zh. F., Scientific Research Institute of Mechanics and Applied Mathematics, Rostov State University

[Abstract] The following problem was formulated: develop an effective method for forming pencil-beam radiation in a stratified elastic half-space by varying the characteristics of surface vibrational sources, the elements of a seismic antenna. In an earlier study (V. A. Babeshko, et al., DAN, Vol 251, No 6, 1980) it was demonstrated that there is a form of oscillation of a flexible stamp on the surface of a homogeneous isotropic half-space ensuring a stipulated direction of the main lobe of the directional diagram of longitudinal or transverse waves. This work is applied here in solving the considered problem. Since vibrational studies of the crust and mantle are now being made with directional seismic antennas, but no proper allowance is being made for vertical inhomogeneity of the medium, the authors continue their laboratory investigations by determining the form of the contact stresses arising under the stamp as a means for computing the directional diagram. This was accomplished by finding the parameters of the surface loads necessary to achieve a maximum contrast of radiation. The example used in illustrating the method was a system of circular regions of a unit radius with a parabolic load distribution. The directional diagrams were plotted for 2, 4 and 6 regions with the distance between centers of regions equal to three radii and the medium was a homogeneous half-space. It is shown that with an increase in the number of regions the side lobes of the directional diagram are suppressed. Figures 3;

References: 6 Russian.

[104-5303]

UDC 550.837

METHOD AND RESULTS OF STUDY OF GEOELECTRIC SECTION IN GARM POLYGON

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 4, Feb 82
(manuscript received 20 Jul 81) pp 834-837

ZHURAVLEV, V. I. and SIDORIN, A. Ya., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] Electrical methods have been employed in the Garm polygon for studying earthquake potential, but this has been hampered by a poor knowledge of the geoelectric structure of the region. Nevertheless, the prerequisites for such studies existed: a stationary system for observing variations of impedance using powerful individual current pulses generated by the "Pamir-1" magnetohydrodynamic apparatus and discharge of a high-voltage bank of capacitors through an electric dipole; algorithms and programs for spectral analysis were available for processing the recorded signals. These and other circumstances enabled the authors to study the geoelectric section to depths of 10-15 km. This article is limited to an interpretation of the results of observations. The interpretation was made for a horizontally stratified model with use of theoretical frequency sounding nomograms (the frequency range only to 5 Hz was used). Frequency sounding curves were constructed, which were interpreted using amplitude and phase nomograms and empirical expressions were derived for relating these curves to cross section parameters. This made it possible to construct geoelectric cross sections for the northern and southern sections of the polygon (velocity sections are also shown). The geoelectric and velocity sections agree well. It appears that there is a high-resistance layer at depths of 5-10 km and this would make it extremely difficult for soundings with a d-c current to detect anomalous resistivity changes at greater depths; frequency sounding would have to be used for that purpose. Figures 1; references: 15 Russian.
[104-5303]

UDC 550.834

DETERMINING BOTTOM OF CRUST FROM SEISMIC WAVE VELOCITY GRADIENT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 4, Mar 82 (manuscript received 10 Jun 81) pp 956-959

ZLOBIN, T. K., Sakhalin Multidiscipline Scientific Research Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Novoaleksandrovsk, Sakhalinskaya Oblast

[Abstract] The identification of the bottom of the crust as the Mohorovicic discontinuity with a boundary velocity of 7.5-7.6 km/sec encounters serious difficulties: in some cases there are several M discontinuities and in other cases the boundary velocity is considerably different from the accepted value.

This has made determination of the bottom of the crust and crustal thickness unreliable. Accordingly, the author has sought an additional physical parameter: the derivative of seismic velocity (its gradient). This has been suggested by earlier work in which it was shown that the rocks of the mantle and basement differ with respect to velocity gradient by a factor of 10-14, whereas with respect to velocity they differ only by a factor of 2-2.5. The crust-mantle discontinuity can be discriminated using the vertical velocity gradient $g(H)$; a study revealed that on the basis of the velocity gradient the M discontinuity is discriminated more clearly. The $g(H)$ curve also makes it possible to break the lithosphere down into layers and characterize them on the basis of the velocity gradient. Such data can be used as an additional characteristic in making a geological interpretation of seismic data. Figures 2; references: 10 Russian.

[143-5303]

UDC 538.3:550.346

ELECTROMAGNETIC RADIATION GENERATION DURING ACOUSTIC WAVE TRANSMISSION THROUGH CRYSTALLINE DIELECTRICS AND SOME ROCKS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 4, Mar 82 (manuscript received 18 Jan 82) pp 839-842

KHATIASHVILI, N. G. and PEREL'MAN, M. Ye., Geophysical Institute, Georgian Academy of Sciences; Cybernetics Institute, Georgian Academy of Sciences, Tbilisi

[Abstract] The physical mechanisms of generation of electromagnetic emission at an earthquake focus were investigated by the authors in DAN, Vol 256, p 824, 1981. In this communication the authors outline still another possible mechanism of generation of electromagnetic emission during the course of preparation of earthquakes, during and after such events. It has been found that when ultrasound of an adequate intensity passes through an ionic crystal of a dielectric electromagnetic emission is generated at the frequency of the ultrasound; similar results have been obtained with some rocks. This effect can be attributed to the appearance and oscillation of charged linear dislocations in the ultrasound field and at a greater ultrasound intensity the sides of the microfissures tend to close and spread apart. Under the influence of elastic vibrational stresses the dislocations begin to oscillate. Various factors can be involved in the transmission of an ultrasonic wave through a dielectric, among them, lattice defects. Processes of defect formation and processes of parametric generation of electromagnetic emission by these defects in an acoustic field are examined in detail. It is clear that the generation of such emission with a sufficiently low frequency, proportional to the frequency of ultrasound, can be caused only by effects associated with fissures and dislocations. The calculations presented here indicate that oscillations of charged dislocations should lead to the generation of electromagnetic emission; the inverse effect should also be observed: in a variable electromagnetic

field charged dislocations, beginning to oscillate, will emit acoustic oscillations at the frequency of the electromagnetic field. In the processes of fissure formation and propagation of powerful acoustic waves in rocks virtually all the components entering into these rocks should make contributions to the generation of electromagnetic emission. References 15: 14 Russian, 1 Western. [143-5303]

UDC 550.849

REMOTE LASER METHODS FOR FINDING MINERAL DEPOSITS

Moscow SOVETSKAYA GEOLOGIYA in Russian No 11, Nov 81 pp 106-117

NAZAROV, I. M., NIKOLAYEV, A. N. and FRIDMAN, Sh. D., Institute of Applied Geophysics

[Abstract] The use of remote laser methods in the search for mineral deposits is examined on the basis of a review of the Soviet and foreign literature. The first part of the text gives a listing and discussion of the gas indicators of deposits and it is made clear that the intensities of anomalously high concentrations are dependent on the nature and thickness of covering deposits, hydrogeological, climatic and meteorological conditions. The laser method for detecting such deposits is based on use of the processes of absorption, scattering or reradiation (fluorescence) of laser radiation by the detected gases. As is thoroughly discussed in the analysis of different modifications of the laser method, the sensitivity of the spectral analytical methods is dependent on the intensity of processes of interaction between the sounding radiation and the detected substance, background noise and instrument parameters. These modifications include resonance absorption, resonance fluorescence and resonance combination scattering. The variants of laser absorption methods discussed most fully here are the integral method of resonance absorption, frequency modulation method and lidar method of different absorption. A table gives the minimum detectable concentrations of gas indicators of deposits for the latter three variants. The combination light scattering and resonance fluorescence methods are given due attention, followed by an analysis of Table 3, indicating the applicability of different laser sources and methods for detecting gas indicators of deposits. The organization of field work is covered in lesser detail, but with the example of geochemical search for gas and petroleum deposits by remote laser spectrometry of methane. Figures 4; tables 3; references 20: 13 Russian, 7 Western.

[89-5303]

DEEP STRUCTURE OF CENTRAL ASIA

Moscow SOVETSKAYA GEOLOGIYA in Russian No 11, Nov 81 pp 89-105

BELYAYEVSKIY, N. A. [deceased] and VOL'VOVSKIY, B. S., Interdepartmental Geo-physical Committee, USSR Academy of Sciences, VOL'VOVSKIY, I. S. and KUNIN, N. Ya., Institute of Physics of Earth, USSR Academy of Sciences, SEMOV, V. N., All-Union Scientific Research Institute of Geophysics, and TAL-VIRSKIY, B. B., Tashkent University

[Abstract] Central Asia has been studied quite thoroughly and the available data now make it possible to predict the presence of petroleum and gas in deep horizons and in major structures. This can be done by analyzing the correlation between crustal structure and the thickness and composition of sedimentary deposits. The region has been studied by drilling, regional and detailed geo-physical methods, deep seismic sounding and earthquake exchange waves, supplemented by magnetotelluric sounding, large-scale gravimetric and magnetic surveys. The total extent of deep seismic sounding profiles is more than 8000 km, the densest coverage in the USSR. These and other studies made it possible to construct velocity models of the crust for correcting earlier published sections (Figs. 1 and 2), which were employed in constructing maps of basement relief (Fig. 3) and the Mohorovicic discontinuity (Fig. 4). After a thorough discussion of the relief of the basement surface and the relief of the Mohorovicic discontinuity there is a detailed tabulation of types of correspondence of structural plans of the basement and Mohorovicic discontinuity. A regionalization of the western part of Central Asia on the basis of types of interrelationship between structure of the basement and the Moho is shown in Fig. 5. An important section deals with the correlation between deep structure and the presence of petroleum and gas. The most important of the petroleum and gas regions are associated with zones of intensive downwarping of the consolidated crust in the Amu-Darya syneclyse, the South Caspian and Caspian depressions, and in the Southern Mangyshlak downwarp. Less important zones are in the Fergana, Afghan-Tadjik and Northern Ustyurt depressions. The major petroleum and gas regions are associated with structures with a differentiated structure of the consolidated crust and considerable gradients of relief of the Mohorovicic discontinuity, zones with an inverse relationship of relief of the basement surface and Moho, zones of a marked decrease in thickness of the upper low-velocity "granite" layer. Various other structures and areas have been defined which warrant continuing reconnaissance and exploration. The article is said to represent the first attempt at study of the relationship between the presence of petroleum and gas and deep crustal structure over an extensive region. Tables 1; figures 5; references: 21 Russian.

[89-5303]

IMPROVING PROCEDURES FOR FORMING SEISMIC IMAGES BY CONTROLLABLE DIRECTIONAL RECEPTION METHOD

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 10, Oct 81 (manuscript received 25 Mar 80) pp 114-122

ZAVALISHIN, B. R., Institute of Petrochemical and Gas Industry, Moscow

[Abstract] Algorithms for the approximate continuation of seismic wave fields are formulated using solutions of the scalar wave equation. These so-called migration algorithms are employed for contending with regular noise, refining the velocity characteristics of the medium and reducing transform noise. The approximate integral continuation of the wave field with construction of a dynamic deep section is accomplished using a dynamic transform, which involves the summing of seismograms or time sections along diffraction hyperbolas. Therefore the author has developed an application of this approach for the scaling of summed records obtained by the controllable directional reception method into the deep region as a dependable method in constructing seismic images. This involves a number of difficulties, the most important being an increase in the reliability of identification of regular waves and the accuracy in determining their parameters by upgrading the noise immunity of the controllable directional reception summation procedure. The solution proposed here is called matched summing, a variant of analysis of time fields for determining the effective parameters of reflected waves, a special case of the multidimensional summation method. The technique outlined here is helpful in precluding the loss of wave information on reflections from differently tilted discontinuities during the accumulation of data from multiple observations. It enhances noise immunity and the quality of summing on short bases by a preliminary accumulation of data. Resolution and accuracy in computing wave parameters are improved. The characteristic noise of the controllable directional reception transform in the construction of images is reduced. The sequence of computations required in this procedure is illustrated in an example. Figures 3; references 17: 12 Russian, 5 Western.

[80-5303]

UDC 525.14:551.248.2

CORRELATION BETWEEN MANIFESTATIONS OF PRESENT-DAY GEOTECTONIC ACTIVITY AND EARTH'S FIGURE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 2, Mar 82 (manuscript received 19 Jun 81) pp 416-420

SHTENGELOV, Ye. S., Odessa State University

[Abstract] The author analyzes the correlation between the location of present-day geotectonic activity and the figure of the geoid. It is noted that all seismovolcanic island arcs (except for the Caribbean) and all active continental margins are located where the geoid rises above the geodetic ellipsoid; geoid prominences have a higher seismicity and about 83% of all epicenters of earthquakes with $M \geq 6$ fall in such regions, as well as about 86% of all volcanoes and most areas of mud volcanism. With respect to the rising and submergence of shorelines, a rising dominates in areas of geoid excess, submergence corresponds primarily to geoid depressions and there is a positive correlation between the occurrence of rising shorelines and height of the geoid. The mean rate of linear dilatation and compression of the earth's surface in the horizontal plane was computed in order to compare recent horizontal crustal movements and geoid geometry. It was found that present-day horizontal dilatation clearly predominates over compression. The dilatation rates are greater in areas of geoid excess, most regions of horizontal compression are now associated with geoid depressions and sectors with maximum rates of present-day horizontal dilatation correspond to the boundaries between geoid excess and depressions. All this, the author postulates, indicates a present-day spatially nonuniform increase in the earth's dimensions, primarily in regions of geoid excess. In addition, there is a correspondence between geoid relief and the main geomagnetic field; both magnetic poles and the Brazilian and East Siberian anomalies are associated with geoid depressions. Figures 3; tables 1; references 5: 4 Russian, 1 Western.

[141-5303

UDC 551.24.035"551.24.242

BEHAVIOR OF TECTONIC DISLOCATIONS AT DIFFERENT CRUSTAL DEPTH LEVELS ACCORDING TO REFLECTED WAVES METHOD DATA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 2, Mar 82 (manuscript received 22 Jun 81) pp 412-416

SHAROV, V. I. and GRECHISNIKOV, G. A.

[Abstract] The characteristics of tectonic faults at different deep levels were determined in studies for tracking faults in the crystalline layer by the modified reflected waves method. In the model formulated by the authors fault zones are regarded as inhomogeneous strata with a complex fine-layered internal

structure, characterized by reduced velocities of elastic waves, high absorption of elastic energy and anomalous density. In the seismic frequency range faults can be traced in the form of reflecting strata. The method was investigated on the Ukrainian shield over an area of more than 4000 km²; the reflecting properties of tectonic dislocations were registered in the depth range 0-15 km. In the depth range 2-3 to 10 km the dips average 32-35°; in more shallow layers the dislocations become near-vertical; below 10 km they begin to flatten out and at 13-14 km the dips are about 20°. To depths of 2-3 km the intensity of the reflections is small and frequently is less than the background. At lower levels there are clear reflections. This change in reflecting properties and dips at different depths is due to a change in the types of destruction, attributable to pressure, temperature, loading rate, internal structure and composition of matter. The existence of regions with different types of destruction conforms to the Peyve concept of global tectonic differentiation of the lithosphere. Prerequisites exist for disharmonious subhorizontal movements of layers within the lithosphere. Figures 3; references: 8 Russian.

[141-5303]

UDC 550.83

PRESENCE OF NONLINEAR EFFECTS ACCOMPANYING PROPAGATION OF ELASTIC WAVES IN ROCKS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 2, Mar 82
(manuscript received 10 Nov 81) pp 314-316

BAKULIN, V. N. and PROTOSENYA, A. G.

[Abstract] Geophysical data not considered in the linear theory of elasticity must be taken into account in earthquake prediction computations. The mechanical characteristics of rocks under high loads exhibit considerable nonlinearity with levels of uniaxial deformation 5-10%. In analyzing this question the authors use as a point of departure a nonlinear-elastic model having the properties of homogeneity and isotropicity. Due to nonlinear properties the velocity of propagation of small disturbances in a deformed medium is dependent both on the properties of the material and on the magnitude of initial deformation. In studies of this type use is made of the third-order constants m , l and n in the expression for the specific energy of deformation (these constants were proposed by F. D. Murnagan in AMER. J. MATH., Vol 59, pp 235-260, 1937). D. S. Hughes and I. I. Kelly, PHYS. REV., Vol 92, No 5, 1953, on the basis of the theory of Murnagan deformations, derived seven equations for computing m , l and n using the results of ultrasonic tests in materials under conditions of uniaxial and hydrostatic pressures. These formulas were used in computing the third-order elastic constants for rocks of the Khibinyy complex. Experiments with an ultrasound apparatus made it possible to detect relative velocity changes of 0.5-1.0%, at the same time ensuring estimates of the elastic constants with an accuracy to 3-5%. Longitudinal and shear waves were measured

using a 100-ton hydraulic press with samples measuring 100 x 100 x 40 mm with stepped loading up to 1000 kg/cm² (not exceeding the elastic limit of the rocks). Ultrasound frequency was 330 KHz. Velocity changes under stress were 5-15%. The third-order elastic constants for Khibinny rocks can be interpreted within the framework of nonlinear elasticity theory for computing the main operative stresses. Tables 2; references 12: 9 Russian, 3 Western.
[141-5303]

UDC 550.340.5

NATURE OF TEMPORAL FLUCTUATIONS OF ROCK RESISTIVITY IN ACTIVE FAULT ZONES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 263, No 2, Mar 82
(manuscript received 19 Nov 81) pp 311-313

AVAGIMOV, A. A. and LYKOV, V. I., Seismology Institute, Turkmen Academy of Sciences, Ashkhabad

[Abstract] Integrated studies, including daily laser pulsed-light rangefinder observations of deformation processes and observations of rock conductivity three times a day by the method of sounding with artificial formation of a vertical magnetic field in a micropolygon were carried out in the search for earthquake precursors. The micropolygon was situated in the Ashkhabad seismically active region at the southeastern end of a linear segment of the Perekovoy deep fault in the Kopetdag. The article gives results for a period preceding a local earthquake occurring on 6 October 1979 which occurred 80 km from the micropolygon. A comparative study of resistivity and deformation curves indicated that the temporal variations of both curves have features in common, the general background being characterized by a baylike shape of the curves, complicated by short-period fluctuations. There was a well-expressed change in resistivity late in September after a marked dilatation of the fault zone; beyond the fault zone the initial resistivity level was restored at the same time. A time lag in the change in resistivity behind deformational anomalies was related to some inertia of water saturation. A baylike change in background values was indicative of the appearance of an earthquake preparation process and the presence of synchronous short-period fluctuations indicated that fault zone conductivity is dependent on the degree of its deformability. The degree of influence of change in the stressed state on conductivity is dependent on water saturation of the section, water mineralization and stratum pressure. On this basis a prediction was made 7 days prior to the earthquake. Figures 3; references: 3 Russian.

[141-5303]

UDC 550.831+838

SOLUTIONS OF DIRECT PROBLEMS IN GRAVIMETRY AND MAGNETOMETRY FOR ARBITRARY HOMOGENEOUS POLYHEDRONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 5, Feb 82
(manuscript received 19 Jun 81) pp 1095-1099

STRAKHOV, V. N. and LAPINA, M. I., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] Formulas are derived expressing the elements of the fields of homogeneous polyhedrons optimum with respect to the simplicity with which they are constructed and the compactness of their description, with respect to region of applicability (correct for both external and internal fields) and with respect to simplicity of programming and speed. Formulas (9)-(14), together with (5)-(8), give a full description of potential in its first, second and third derivatives in coordinates for an arbitrary homogeneous polyhedron. Expressions for elements of the fields of arbitrary uniformly magnetized polyhedrons are derived from the expressions for the elements of gravitational fields of the same polyhedrons using the Poisson theorem. Formulas (15)-(17) and (9)-(14) give a full description of elements of external and internal magnetic fields of arbitrary uniformly magnetized polyhedrons. FORTRAN-IV language was used in writing programs for computing the elements of gravitational fields of convex uniform polyhedrons and for computing the elements of magnetic fields of convex uniformly magnetized polyhedrons in two variants: for computing the elements only of external fields and for computing field elements at any points (external and internal). The programs were checked by testing a 48-side polyhedron inscribed in a sphere. The average time for computing field elements at 100 points, including auxiliary procedures, was 15 sec for computing external fields and 18 sec for computing external and internal fields. References 6: 4 Russian, 2 Western.

[109-5303]

UDC 550.347.2

DISTRIBUTION OF SURFACE WAVE GROUP VELOCITIES IN NORTH ATLANTIC

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 82
(manuscript received 7 Jul 81) pp 3-11

YANOVSKAYA, T. B., Physics Faculty, Leningrad State University

[Abstract] In an earlier study (VYCHISLITEL'NAYA SEYSMOLOGIYA, No 13, Moscow Nauka, pp 96-101, 1980) the author made a generalization of the Backus-Gilbert method (PHIL. TRANS. ROY. SOC. LONDON, SER. A, Vol 266, No 1173, pp 123-192, 1970) for the case of a two-dimensional velocity distribution and this method was developed applicable to a study of the velocity section using data on the travel times of refracted body waves. Continuing his work along these lines,

the author now demonstrates that it is not difficult to employ this method for studying the velocity distribution of surface waves. This is illustrated in an investigation of the distribution of the group velocities of surface waves in the North Atlantic, making it possible to reveal some characteristic features of upper mantle structure in the neighborhood of an oceanic rift. The data base employed was information on the group velocities of Rayleigh waves corresponding to periods $T = 20, 30, 40, 50$ and 60 sec along paths intersecting the North Atlantic. Data for 36 trajectories were used for periods 20-50 sec and for 33 trajectories for a period of 60 sec. The findings presented here reveal that the Backus-Gilbert method can be employed in studying horizontal inhomogeneities of the crust and upper mantle and for tracing the change in horizontal inhomogeneities with depth. Specifically, in the North Atlantic it was found that there is a difference in the structure of the blocks to the west and east of the Mid-Atlantic Ridge at small depths. In addition, there is a decrease in velocity in the rift zone at greater depths and at these depths the differences between the structures of the western and eastern blocks disappear. Finally, it was noted that there is a "column" of reduced velocity rising from the mantle in the Azores region. Figures 4; references 8: 3 Russian, 5 Western.

[137-5303]

UDC 550.347.62

MATHEMATICAL MODELING FOR SOLVING TWO-DIMENSIONAL INVERSE PROBLEM USING DEEP SEISMIC SOUNDING DATA

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 82
(manuscript received 27 Sep 80) pp 12-22

PAVLENKOVA, N. I. and PSHENCHIK, I., Institute of Physics of Earth imeni O. Yu. Schmidt, USSR Academy of Sciences; Geophysical Institute, Czechoslovak Academy of Sciences

[Abstract] In this article the authors examine the inverse two-dimensional seismic problem in the following way: "Along the observation lines x there is stipulation of a system of counter and overtaking travel-time curves of seismic waves of different types and their amplitude curves. It is necessary to determine the velocity model of the medium $v(x, z)$, arbitrary in the plane x, z , but constant for any section parallel to the profile (z is depth). The function $v(x, z)$ is deemed a solution of the problem if the waves computed for it coincide with the observed waves with a stipulated error for their times and amplitudes. The medium may contain sharp seismic discontinuities, transition zones, layers and bodies with increased and reduced velocities." The solution is employed here in the processing of data from deep seismic sounding, employing both the kinematic and the amplitude characteristics of the waves. The entire mathematical modeling procedure is outlined, with a description of the RATLIM program developed for computing the travel times and amplitudes of reflected and refracted waves in horizontally inhomogeneous media. The authors succeed

in demonstrating that the described modeling makes it possible to broaden the range of investigated media, at the same time determining the character of the wave field main components. Figures 4; references 28: 18 Russian, 10 Western. [137-5303]

RESULTS OF OBSERVATIONS IN TRIANGLE OF SEISMIC STATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 82
(manuscript received 10 Apr 80) pp 79-84

SAVARENISKIY, Ye. F. (deceased), STAROVOYT, O. Ye., CHEPKUNAS, L. S. and YAVORSKIY, I. R., Institute of Physics of the Earth imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] This is a continuation of an earlier investigation (Ye. F. Savarenskiy, et al., "Determination of Azimuth to Epicenter Using Data From Three Close Stations," IZV. AN SSSR: FIZIKA ZEMLI, No 7, pp 106-111, 1969). The objective of this continuing study was an improvement in determining the coordinates of earthquake foci, especially the azimuths from stations to the epicenter, and ascertaining the stability of evaluations of dynamic characteristics. The seismic stations were in the Moscow area and formed a triangle with 100-km legs. Azimuths were determined using seismograms of 12 earthquakes uniformly surrounding the triangle. Data on the arrival times of different seismic waves (longitudinal P, transverse S; surface L) were used. Several different methods were used in determining azimuth: employing the standard formula of spherical geometry, using the coordinates of two points (focus and station), and on the basis of the ratio of amplitudes of oscillations in seismic waves registered at one station at the same time in horizontal components (B. B. Golitsyn method). A table gives data on the principal focal parameters of the selected earthquakes, epicentral distances to station No 1 and azimuths to the epicenters as determined by different methods. The differences in azimuths ΔAz are given and explained. The results show that use of data for a triangle of stations increases the reliability of the sought-for parameters. Figures 4; tables 4; references: 7 Russian.

[137-5303]

RESULTS OF REGISTRY OF SHORT-TERM ELECTROMAGNETIC EARTHQUAKE PRECURSORS
IN JAPAN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 82
(manuscript received 21 Oct 80) pp 85-87

GOKHBERG, M. B., YOSHINO, T., MORGUNOV, V. A. and OGAVA, T., Institute of Physics of the Earth, USSR Academy of Sciences; University of Electrocommunications, Tokyo; Kyoto University

[Abstract] Electromagnetic emission in a wide range of radio frequencies appears during the period of earthquake preparation and emission anomalies associated with seismic activity have special properties which make them stand out against a background of atmospheric and industrial noise. A study of this phenomenon was made by the Institute of Physics of the Earth in collaboration with the Tokyo University of Electrocommunications. Tokyo University and Kyoto University. Synchronous observations were made using surface and underground sensors in a highly seismically active region of Japan near Matsushiro, measurements being at two points 30 km apart with independent instrumentation. A standard RCA (CR-11A) triple superheterodyne radio receiver was used in the measurements (received frequencies 14-600 KHz). An earthquake with a magnitude $M = 7$ with a focal depth 480 km was registered on 31 March 80 with the epicenter 35.4°N , 135.3°E . Thirty minutes prior to the earthquake there was an anomalous increase in background intensity. There was a sharp dropoff in the signal to a normal level at the time of the earthquake. An independent registry of VLF emission confirmed that an electromagnetic emission anomaly appears before any earthquake: earlier it was assumed that an electromagnetic emission anomaly is absent for all deep-focus earthquakes and is characteristic only of crustal earthquakes. The study clearly suggests the desirability of further measurements of electromagnetic emission with surface and underground placement of detectors in a network of stations in regions of increased seismicity in order to ensure registry of this significant precursor. Figures 3; references: 5 Russian.

[137-5303]

UDC 550.342

CORRELATION BETWEEN STORM MICROSEISMS AND HIGH-FREQUENCY SEISMIC NOISE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 2, Feb 82
(manuscript received 6 Aug 80) pp 88-91

RYKUNOV, L. N., STAROVYOT, Yu. O., KHAVROSHKIN, O. B. and TSYPLAKOV, V. V.,
Institute of Physics of the Earth imeni O. Yu. Shmidt, USSR Academy of Sciences;
Physics Faculty, Moscow State University imeni M. V. Lomonosov

[Abstract] There is a correlation between the level of seismic noise (10-60 Hz) and long-period deformational processes. A phenomenon similar to acoustic emission is the basis for the possible mechanism of transformation of the energy of long-period seismic processes into the energy of high-frequency seismic noise. Emphasis in this article is on the correlation between high-frequency seismic noise and deformations caused by storm microseisms in the range of periods $T \sim 4-7$ sec. The background level of storm microseisms was determined using an SKD seismograph; a histogram of the distribution of microseism periods for a period of one week was constructed, with a maximum of this distribution in the range 5-6 sec. Registry at "Obninsk" station was during the periods 2 January-28 January 1979 and 7 February-14 February 1979. During both periods the seismic noise level at certain times increased by several times in comparison with the undisturbed level, with some dependence (both temporal and amplitude) between the level of high-frequency noise and the background of storm microseisms. With a probability $P \geq 0.99$ there is a correlation between the seismic noise level and storm microseisms. Figures 4; references: 6 Russian.
[137-5303]

UDC 553.98 (571.5)

PRESENCE OF PETROLEUM AND GAS IN EASTERN SIBERIA

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian No 1, Jan-Feb 82 (manuscript received 12 May 81) pp 37-44

SOKOLOV, B. A., KORCHAGINA, Yu. I., YEGOROV, V. A., TROFIMUK, A. A. and USMANOV, I. Sh., Moscow State University

[Abstract] The sedimentary deposits of Eastern Siberia extend over an area of 3.5 million square kilometers and have a thickness as great as 10-12 km. Until now it has been primarily gas deposits which have been discovered, and on a relatively modest scale. This article is an assessment of the probability of finding gas and petroleum in this region. An analysis is given of the features of structure and history of formation of the Siberian Platform and each individual basin. All the pertinent formations are mapped in Fig. 1. The investigation was made applying the evolutionary-genetic method for

evaluating the prospects of finding petroleum and gas, a method which is contingent on the proper interpretation of geological structure and geological development of the studied area. Much important geological information is still schematic. Emphasis is on the structures and evolutionary processes which appear most promising. The presently available materials suggest that the discovery of significant petroleum deposits is entirely possible, but too little reconnaissance and exploration has been carried out at present to validate this conclusion. Various technical and scientific innovations are required to adequately study the region, since many conditions differ considerably from other productive areas in the country. Figures 3; references: 12 Russian.
[130-5303]

UDC 550.38

INTERPETING ANOMALIES OF VARIABLE GEOMAGNETIC FIELD BY MOMENTS METHOD

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian No 1, Jan-Feb 82 (manuscript received 12 May 81) pp 92-94

KRYLOV, V. A., Moscow State University

[Abstract] In the interpretation of anomalies of the variable geomagnetic field an effective procedure is the Strakhov moments method. The Strakhov algorithm was developed on the basis of expansion of the fields of limited sources into multifield components. In this article the author determines the accuracy which the Strakhov algorithm ensures when applied to the variable geomagnetic field. (The properties of the algorithm are briefly reviewed and examined as applicable to an illustrative case: a homogeneous earth with the conductivity $\sigma_n = \text{const}$ with a two-dimensional inhomogeneity with a different conductivity and with incidence of a plane homogeneous electromagnetic wave on the earth's surface). A program was formulated involving solution of the direct problem and application of an algorithm for computing the moments. Computations were made for two-dimensional models with a square inclusion (100 km^2) with a depth of 10 km to the top. Four $\Delta\sigma$ variants were examined, analytical solutions of the direct problem were obtained for each variant, and tested with the Strakhov algorithm. The values of the moments obtained in this way were compared with the true values and the relative errors were computed. It was found that the algorithm can be used in interpreting anomalies of the variable geomagnetic field if σ_n does not differ greatly from zero and the error in determining the parameter ξ_{cen} (the center of anomalous currents) is attributable to the fact that the real conductivity σ_n is far greater than 0. Tables 1; references: 4 Russian.
[130-5303]

UDC 550.831

SOLVING DIRECT PROBLEM IN GRAVIMETRIC PROSPECTING FOR BODIES OF ARBITRARY FORM
USING MODERN ELECTRONIC COMPUTERS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 4: GEOLOGIYA in Russian
No 1, Jan-Feb 82 (manuscript received 9 Jun 80) pp 95-98

LITVINENKO, O. K. and KHA LYONG TIN, Moscow State University

[Abstract] Density gradient media are the most general models in gravimetric prospecting. Numerical methods for solving the direct problem on a computer with a decrease in the discretization interval make it possible to compute the direct problem from a model with an adequately complex stipulated law of density change as a function of the coordinates of the body, but the authors feel that it is more effective, especially in the multisided interpretation of geophysical data, to create methods and algorithms for a definite law of change of density as a function of the coordinates of a body, such as a linear or exponential law. The article examines methods for solving the direct problem when bodies are approximated by the sum either of two-dimensional horizontal prisms or parallelepipeds, in each elementary body the density changing linearly or exponentially. A series of expressions is derived, one of which can be selected (depending on the form of density change) for making computations for one-dimensional gradient media with a change in density as a function of depth or coordinate. Application of these expressions requires formulation of a "computer-independent" program. Structural programming is used for this purpose. In the programming the algorithm is broken down into individual modules, each having independent functional importance; these modules have a hierarchical structure. Each of the modules in the main program are described and graphically represented. This program for solving the direct problem is written using FORTRAN-IV language. Figures 1; references: 9 Russian.

[130-5303]

UDC 550.344.094.43

DETERMINING ABSORPTION AND SCATTERING COEFFICIENTS BY JOINT ANALYSIS OF
REGULAR WAVES AND CODA

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 82
(manuscript received 10 Oct 79) pp 48-62

KOPNICHEV, Yu. F., Institute of Physics of the Earth imeni O. Yu. Shmidt,
USSR Academy of Sciences

[Abstract] In this article the author gives the development of new methods devised for determining crust - upper mantle absorption and scattering coefficients. These are based on an interpretation of regular waves and the coda, as well as use of models of multiple isotropic scattering of seismic waves.

After evaluating the limits of applicability of models of single and diffusional scattering, the absorption and scattering coefficients are evaluated for the crust and top of the mantle in the Garm region and in the Northern Tien Shan. The author makes clear that models of single and diffusional scattering cannot be used in interpreting the coda of near earthquakes in these regions. At a frequency $f \approx 1$ Hz absorption in the crust and at the top of the mantle is somewhat greater than scattering; at $f > 5$ Hz the scattering coefficient becomes greater than the absorption coefficient but the ratio of the α_{abs} and α_{scat} values varies considerably in different regions. The scattering coefficient is approximately proportional to the level of weak seismicity, indicating the important role of fractures in the scattering of seismic waves in the crust of seismically active regions. The α_{abs} and α_{scat} values in the lower mantle are 1-1.5 and 1-3 orders of magnitude less than in the lithosphere. The observed temporal changes in attenuation of seismic waves reported by some authors are probably associated with variations of the scattering characteristics of the medium. Figures 2; tables 5; references 40: 32 Russian, 8 Western.

[121-5303

UDC 550.837.6(571.66)

CONDUCTIVITY OF CRUST AND MANTLE ON KAMCHATKA ACCORDING TO MAGNETOTELLURIC SOUNDING DATA

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 82
(manuscript received 15 Jan 80) pp 76-85

MOROZ, Yu. F., Eastern Geophysical Trust, RSFSR Geology Ministry

[Abstract] Since 1970 specialists at the Eastern Geophysical Trust have been carrying out magnetotelluric soundings on Kamchatka for studying the structure of Mesozoic-Cenozoic formations and the deep geoelectric section. A total of 250 soundings were made in the range 1-2000 sec in a nonuniform network, the sounding density being one sounding each 50-100 km². Figure 1 is a map showing the areas investigated. The geoelectric section is described on the basis of data from studies of telluric currents, magnetotelluric sounding and vertical electric sounding. Three regions with different geoelectric sections were defined: platform, transitional and volcanic; these are shown in Fig. 2. The different types of magnetotelluric sounding curves for the different regions are shown in Fig. 3. Geoelectric sections of the crust and upper mantle are shown in Fig. 4. The characteristics of the geoelectric section are reflected in tectonics, magmatism, hydrothermal activity and heat flow. The existence of conducting layers in volcanic zones agrees with the distribution of velocities of elastic waves. The principal conducting layer, in the region of joining of Kamchatka with the Okhotsk epi-Mesozoic platform at a depth of 100-150 km, rises in volcanic zones to depths of 30-50 km. The nature of this layer is related to the fractional melting of ultrabasic (basic) rocks occurring at

temperatures greater than 1100°. The intermediate conducting layer rises in the volcanic zone to depths of 8-15 km, with its existence being attributable to the dehydration of rocks in the temperature range 400-800° and enrichment with well-conducting solutions and also fractional melting of rocks of the granulite facies at temperatures greater than 600° in the presence of highly activated waters. A considerable role in the development of conducting layers of volcanic layers is played by deep faults with which magmatic and hydrothermal activity is associated. Figures 4; references 35: 33 Russian, 2 Western. [121-5303]

UDC 550.341

ELASTIC WAVE RADIATION BY FRACTURE INVOLVING DISPLACEMENT AND SEPARATION ELEMENTS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 1, Jan 82 (manuscript received 25 Jul 81) pp 88-92

STRIZHKOV, S. A. and PAVLOV, A. A., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] Laboratory experiments with the destruction of model materials and rocks have shown that the process of preparation of a shear macrofissure or fault includes the formation of an echelon of separated fissures. The authors undertook a model experiment to ascertain the nature of the elastic waves and rate of separation observed during displacement along a fault consisting of shear and separation elements. The experiments, described here in detail, were made using Plexiglas samples having the form of plates measuring 150 x 150 x 10 mm. The pulses radiated during the induced events were registered by piezoelectric sensors and recorded with an electronic oscillograph. This made it possible to ascertain the nature of the radiation, vertical and horizontal displacements. It was found that an increase in the number of displacement and separation elements results in a change in the form of the directional diagram, but the diagram eventually becomes the same as in the case of movements along a shear fault not involving separation elements. In contrast to the case of movement along a shear fault, the phenomenon of separation of a complexly structured fault is essentially dependent on pressure, which governs whether the separation will be uni- or bilateral. The direction of fault separation can be determined from the appearance of the directional diagram: in a unilateral case the energy maximum is radiated in the direction of separation, but in a bilateral case the predominant direction in which the energy maximum is radiated cannot be determined. The presented data indicate that when determining the parameters of an earthquake focus it is possible to employ the patterns found for a shear fault, regardless of whether the fault is purely of the shear type or consists of displacement and separation elements. Figures 4; references 10: 8 Russian, 2 Western.

[121-5303]

PROBLEMS IN GLOBAL TECTONICS

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR: SERIYA GEOLOGICHESKAYA
in Russian No 1, Jan-Feb 82 pp 33-41

PATALAKHA, Ye. I., Order of the Red Banner of Labor Institute of Geological Sciences imeni K. I. Satpayev, Kazakh Academy of Sciences, Alma-Ata

[Abstract] The author reviews a number of phenomena which give much cause for reflection on the validity of current tectonic concepts on a global basis -- a number questions for which there is yet to be a convincing answer. The following are considered: 1) How is it possible to explain that 2/3 of the earth's area has an oceanic crust? 2) Is diastrophic zonality in the transverse section of geosynclinal-folded zones or lateral migration of the diastrophic process with time characteristic? 3) What is the role of tectonic "crowding" as a characteristic form of the dislocation process? 4) Do the subduction and obduction processes actually exist and what role do they play? 5) Are there many eugeosynclinal spaces embedded in the oceanic crust? 6) What is the nature of the so-called microcontinents? These are discussed briefly, the pros and cons are presented and the dilemmas involved are clarified. These problems are but a few of those which must be solved if global tectonics is to advance further. Researchers should direct their efforts to resolving these questions and in such work very unexpected results may be found. Figures 2; references 17: 16 Russian, 1 Western.

[111-5303]

UDC 550.343.4.001.57:/551.24+551.4/(574-12)

GEOPHYSICAL REGIONALIZATION OF EARTH'S CRUST IN SOUTHEASTERN KAZAKHSTAN AND CONTIGUOUS REGIONS

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR: SERIYA GEOLOGICHESKAYA
in Russian No 1, Jan-Feb 82 pp 42-52

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[Abstract] Since deep geotectonic regionalization is of great importance in solving problems in metallogeny, crustal petrology and in developing a theory of formation and development of the earth's lithosphere, the author undertook such a project for southeastern Kazakhstan, a region where intermittent major earthquakes occur. This undertaking involved a generalization and systematization of geological, geophysical, geodetic and seismological data collected during the last 15-20 years in the Northern Tien Shan and Dzhungarian mountain systems and in contiguous regions. These new data have made it possible to improve the model of lithospheric structure, develop further information concerning deep structure and tectonic conditions and define better the most important elements developing in the most recent era. A major geophysical

inhomogeneity, the "Tien Shan segment," is isolated and described in detail (Fig. 1 is a map of the principal deep crustal elements). One section of the article outlines the geological-geophysical characteristics of deep elements (these are represented in a series of sections shown in Fig. 2). Tabulated data are given for the physical properties of rocks of different megablocks and zones in the "Tien Shan segment" and also the change in the velocity of elastic waves with depth in these structures. The interrelationships of deep and surface geological structures are described. It is clear that the "Tien Shan segment" as a whole and the megablocks, blocks and transitional zones making it up are highly important deep alpine structural geological elements. Figures 2; tables 2; references: 19 Russian.

[111-5303]

UDC 550.348

SEISMIC WAVES GENERATED BY 'DEFORMATIONAL EXPLOSION' WITH FINITE FRONT VELOCITY

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 82 (manuscript received 6 Jun 80) pp 120-128

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[Abstract] In an earlier study (GEOLOGIYA I GEOFIZIKA, No 11, 1978) the author postulated that in those parts of the earth where the intensity of the elastic distortion of form exceeds some critical level there will be a jumplike process of transformation of the elastic distortion of form into an irreversible process and this was called a "deformational explosion." Also postulated was the presence of a disturbance caused by the instantaneous decrease in the intensity of the elastic distortion of form simultaneously at all points in a spherical region. Against the background of this earlier work, the author now examines a model in which the jump of irreversible distortion of form arises simultaneously at points in a sphere whose radius increases at a constant rate, attaining a given size, after which the process ceases. The region where the process of transformation of elastic distortion of form becomes irreversible is called the front and the velocity of its propagation is considered finite. In the formulated model a study was made of the seismic wave field and impulses in the distant zone. It was found that the P and S impulses are not sign-variable, are finite and begin in conformity to the " t^2 " law; the shape of the impulses, their level and energy flux are essentially dependent on v ; the pattern of P waves is determined by the type of deformation and the ratio of irreversible dilatation to the intensity of the irreversible distortion of form, whereas the pattern of S waves is determined only by the type of deformation. With the satisfaction of certain conditions the P waves have a nodal surface in the form of a cone and in the form of one or two planes (in special cases, in the form of two mutually perpendicular planes). In a long-wave approximation a disturbance from the considered source coincides with the disturbance from a point source of the type of three mutually perpendicular balanced dipoles. Figures 4; references 13: 7 Russian, 6 Western.

[124-5303]

UDC 550.837/.838(571.53)

DEEP ELECTROMAGNETIC SOUNDING IN BAM ZONE

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 82 (manuscript received 27 Jun 80) pp 129-133

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[Abstract] Deep electromagnetic soundings have been carried out in the Severo-Muyskiy sector of the Baykal-Amur Railroad. Such work was done primarily by two methods: magnetotelluric sounding and by the artificial formation of an electromagnetic field (AFEMF). This made it possible to construct a geoelectric section of the Muyakanskaya depression to depths greater than 10 km. The strengths and weaknesses of the two methods are discussed in relation to the geological conditions in the area. The work was done in 1979 by combining the two above-mentioned methods. The studied area is an embryonal rift depression within the limits of the Angaro-Vitimskiy granitic batholith. The total thickness of unconsolidated sediments did not exceed 200-250 m. In the upper part of the granite basement there is a zone of fracturing 1-1.5 km in thickness. These and other considerations made it possible to approximate the geoelectric section by a horizontally layered model. The combined use of the two methods compensated for the shortcomings of the methods when used separately, at the same time confirming and strengthening the findings obtained in preliminary work. On this basis it was possible to propose ways to improve the combined method, especially for increasing its effective depth. It was confirmed that in the investigated area there is a conducting layer in the crust at a depth of 10-12 km. More importantly, the experience gained in use of the combined method will be applicable in many other areas of similar geological structure. Figures 5; references: 4 Russian.

[124-5303]

UDC 550.344(571.5)

COMPARISON OF TRAVEL-TIME CURVES OF LONGITUDINAL SEISMIC WAVES FROM EARTHQUAKES AND SHOTS IN BAYKAL REGION

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 1, Jan 82 (manuscript received 16 Jul 80) pp 133-136

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[Abstract] An earlier study gave the results of construction and analysis of the travel-time curves of earthquake seismic waves. Those materials have been combined now with additional data relating to the kinematics of intracrustal and mantle seismic waves in the Baykal region, employing deep seismic sounding

data. Figures 1 and 2 show travel-time curves of P and \bar{P} waves and corresponding curves of first arrivals from deep seismic sounding shots. The travel-times of P waves accompanying earthquakes correspond to the theoretical curves for sources localized at approximately 10-15 km in the crust. The difference in the experimental travel times for elastic waves for natural tremors and shots is about 1.5-2 sec in the northeastern and central parts of the rift zone. The travel time from shots for the southwestern profiles is greater than the travel time of P waves of earthquakes by an average of 3 sec. The great difference is attributable to the fact that crustal thickness in the southwestern part of the Baykal area increases by 10-20 km in comparison with the central and northeastern parts. The refracted intracrustal waves arising from shots along profiles in all three parts of the Baykal region are greater than the travel times of \bar{P} waves from earthquakes by 0.5-1.5 sec. The mean velocity of longitudinal waves throughout the crust according to deep seismic sounding data is 6.4 km/sec. The mean depth of foci, as computed from P travel-time curves, is about 14 km. Comparison of the travel-time curves from earthquakes and deep sounding reveals a good agreement and confirms that the foci of most weak earthquakes are in the upper 10-15 km layer of the crust.

Figures 3; references: 8 Russian.

[124-5303]

UDC 550.3:620.191.33:621.034

CORRELATION BETWEEN SIZE OF FRACTURES FORMING UNDER LOAD AND DURATION OF ELASTIC ENERGY RELEASE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 264, No 4, Jun 82
(manuscript received 22 Dec 81) pp 846-848

KUKSENKO, V. S., LYASHKOV, A. I., MIRZOYEV, K. M., NEGMATULLAYEV, S. Kh., STANCHITS, S. A. and FROLOV, D. I., Institute of Seismic-Resistant Construction and Seismology, Tajik Academy of Sciences, Dushanbe

[Abstract] A study was made of the release of elastic energy during the formation of fractures in mechanically loaded solid bodies in a wide range of size from microns to kilometers. The half-period of increase in the intensity of a longitudinal elastic wave $T/2$ is used as the parameter characterizing the duration of release of elastic energy for a single tremor. In this analysis use was made of weak local earthquakes during the years 1968-1978. The averaging of the L (size of fracture) and $T/2$ parameters was carried out for all earthquakes within one class. The duration of release of elastic energy was characterized by the time of increase in the intensity of the elastic wave longitudinal component. In the laboratory microscopic fractures were obtained using porous glass; it was possible to generate microfractures in a wide range from 10 μm to several millimeters; other materials, such as rods, foils, plates and rock samples were also used. All the experimental data fitted the single dependence $L = V^{\frac{T}{2}}$, where V characterizes the rate of release of elastic energy. For each material there was a limiting rate of development of fractures, being about 0.6-0.7 of the velocity of longitudinal waves. These and

other findings made it possible to propose a model of the preparation and development of a fracture with accompanying release of elastic energy. In the loaded material the mechanical stress is distributed very nonuniformly in the volume and there are overloaded regions. With a load increase in these regions there is more rapid development of deformation and destruction processes at lower scale levels. An important role is played by multiple disperse accumulation of damage, weakening this region. An unstable state is created in this region by some moment in time. With a small load increment or generation of the next small fracture the entire overloaded region fractures, resulting in unloading transpiring at velocities close to the speed of sound. Figures 1; references: 5 Russian.

[177-5303]

PHYSICS OF ATMOSPHERE

UDC 550.388.551.521.326

POSSIBLE CONDITIONS AND REASONS FOR DEVELOPMENT OF POLARIZED RADIATION IN SPECTRUM OF AURORAS AND NIGHT AIRGLOW

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 21, No 6, Nov-Dec 81
(manuscript received 18 Aug 80) pp 1131-1132

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[Abstract] Polarization has been discovered in very few emissions of auroras and night airglow, but a recent study indicated a polarization of night airglow of about 60%, an interesting finding, if correct, because the maximum degree of polarization of the red line of oxygen atoms is only 13.7% if excited by electrons. The author therefore has determined the degree of polarization of emission of atoms if they are excited by streams of charged particles. An explanation was found for the fact that most researchers have not detected polarization. A high percentage of night airglow emission arises during the intercollision of atoms and ions or collision with thermal electrons; in auroras the emission is attributable primarily to slow secondary electrons. Both thermal particles and secondary electrons have a near-isotropic angular distribution and therefore the f_{20} moment of their distribution function is close to zero, accounting for an almost total absence of polarization. However, polarization can be expected in those emissions which are formed in a process with a high threshold energy in which the contribution of primary electrons is maximum. Proton auroras can be expected to exhibit a high degree of polarization, the emissions being formed in a charge exchange process during collision of protons with atmospheric atoms. References 7: 4 Russian, 3 Western.
[97-5303]

EXCITATION OF ROSSBY WAVE SOLITONS BY INTERNAL GRAVITATIONAL WAVES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 5, Feb 82
(manuscript received 19 Jun 81) pp 1089-1091

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[Abstract] In the ionospheric F region internal gravitational waves experience amplitude modulation by planetary Rossby waves. Since nonlinear effects in the upper atmosphere become important beginning at an altitude of 120 km, the authors have investigated the nonlinear problem of excitation by internal gravitational waves of the Rossby wave solitons enveloping them. On the assumption that high-frequency waves are propagated in the atmosphere and that these waves can excite Rossby waves, it is clear that the group velocity of the high-frequency wave in order of magnitude should be equal to the phase velocity of a linear Rossby wave and that the excitation of Rossby wave solitons requires gravitational waves with a finite value of the wave vector. In the case of waves propagating horizontally at a small angle to the zonal direction, the problem is solved using ordinary hydrodynamic equations in a β -plane approximation. An analysis reveals that not only the amplitude and characteristic width of solitons are dependent on the direction of wave propagation, but also the form of the envelope of the high-frequency part of velocity; the low-frequency part of velocity is also dependent on wave direction. The amplitude of solitons is dependent on the frequency of the gravitational wave and the amplitude of the solitons is different for different angles of their propagation. An example is given of the numerical values of the period T, length λ and group velocity V of an internal wave and also the width L and amplitude A_0 of the envelope of a Rossby soliton. References 7: 5 Russian, 2 Western. [109-5303]

MODELING OF STRATOSPHERIC AEROSOL OPTICAL CHARACTERISTICS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 262, No 5, Feb 82 (manuscript received 14 Jul 81) pp 1092-1095

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[Abstract] Models of optical characteristics of atmospheric aerosol were developed for solving problems of radiative heat exchange. In an earlier study (DAN, Vol 253, No 6, p 1354) the authors accomplished "closed" modeling of the optical characteristics of atmospheric aerosol with determination of the attenuation σ_a , scattering σ_a^s and absorption σ_a^a coefficients and the scattering function for the spectrum of wavelengths and for all altitudes. Now they have investigated the optical characteristics of stratospheric aerosol using a priori information on the microstructure and chemical composition of this aerosol. The principal components are the salt fraction, finely disperse fraction of background aerosol, cosmic dust and particles of sulfuric acid solutions. Stratospheric aerosol is less variable than tropospheric aerosol and its optical characteristics are dependent on the intensity of volcanic activity; volcanic aerosol has a substantially different chemical composition than other types of aerosol. In comparison with sulfate aerosol it absorbs radiation to a greater degree in the visible part of the spectrum and to a lesser degree absorbs radiation in the IR spectral region. The ejection of volcanic aerosol into the stratosphere results in an increase in the absorption of visible radiation, whereas the capacity of stratospheric aerosol to absorb long-wave radiation decreases. This aerosol evolves further as a result of gas-chemical transformations of SO_2 with formation of an aerosol of H_2SO_4 solution. With the "aging" of volcanic aerosol there is a decrease in the absorptivity of stratospheric aerosol in the visible part of the spectrum and an intensification of the absorption of long-wave radiation. Variations in the optical characteristics of stratospheric aerosol are determined by the relationship of volcanic aerosol ejected into the stratosphere and newly forming H_2SO_4 aerosols. The concentration of H_2SO_4 solution in stratospheric aerosol should decrease with the transport of stratospheric aerosol from the sites of its generation. These factors and processes, set forth by the authors, enabled them to construct models of the optical density of different fractions of stratospheric aerosol for background conditions and during a period of increased volcanic activity. Figures 2; tables 1; references 8: 2 Russian, 6 Western.

[109-5303]

ARCTIC AND ANTARCTIC RESEARCH

UDC 551.321:621.396.969(99)

MEASUREMENTS OF THICKNESS OF ANNUAL SNOW LAYERS IN ANTARCTIC BY RADAR
SOUNDING METHOD

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 264, No 4, Jun 82
(manuscript received 29 Oct 81) pp 909-911

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[Abstract] The principal difficulty in the use of radar for measuring the thickness of annual snow layers in Antarctica is their small thickness, which ranges from a few centimeters to 2 m. Since the velocity of radio waves in the centimeter and meter ranges in snow with the typical density of 0.4-0.5 g/cm³ is 214-202 mm/nsec, the resolution of a radar set with a pulse duration of 1 nsec can be considered acceptable. Such a resolution can be attained in the range 10 GHz when employing radio pulse radiation. The attenuation of radio waves in this range in the snow is less than 1 db/m and a relatively low-power radar with an energy potential 110-120 db ensures reception of a reflected signal from depths not less than 20 m. A radar with the following technical specifications was used for measuring the thickness of snow layers in Antarctica: wavelength -- 3 cm; pulse duration at 0.25 level -- 1 nsec; peak pulse power -- 10 W; mean radiated power -- 1 mW; amplification factor of each antenna -- 200; receiver response 10⁻¹⁰ W; weight with attachments -- 70 kg; required power -- 500 W. The radar was carried on a cross-country vehicle; the antennas were spaced 0.4 m apart and were mounted 1 m above the snow surface. Signals from the receiver output were fed to an oscilloscope and pulses from the surface and subsurface snow boundaries were registered as lines of bright dots. A radar profile of the snow cover was recorded as the vehicle moved along. The characteristic boundaries were registered and dated. Ice crusts forming in the spring-summer seasons of 1980/1981, 1979/1980 and 1978/1979 were registered. The error in measuring thickness of the snow cover is 5%. The same equipment and method can be used for measuring snow thickness in the middle latitudes and investigating relief under the snow or objects under the snow. Figures 2; references: 3 Russian.

[177-5303]

CSO: 1865

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